WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

MISSION HILL WATERSHED

Yankton County, South Dakota

JANUARY 1975

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
AND THE
FOREST SERVICE

USDA-SCS-LINCOLN, NEBR 1974

WATERSHED WORK PLAN

MISSION HILL WATERSHED

Yankton County, South Dakota

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Mission Hill Watershed District
Yankton County Conservation District
Town of Mission Hill

With assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

January 1975

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ADDENDUM
TO
MISSION HILL WATERSHED WORK PLAN
YANKTON COUNTY, SOUTH DAKOTA

August 1975

This addendum is in three (3) parts. Part 1 shows evaluation of the plan using current discount rate, costs, and normalized prices. Part 2 is the abbreviated Environmental Quality Plan, and Part 3 is the abbreviated display accounts of the Selected Plan.

Part 1

This part shows project benefits based on current normalized prices, costs, and benefit-cost ratio using 6-1/8 percent interest rate. Annual project benefits and costs are:

Benefits	$99,600
Costs	$41,090

The benefit-cost ratio is 2.4 to 1.0 based on current(1974)costs. Without secondary benefits, the benefit-cost ratio is 1.4 to 1.0.

Part 2

ABBREVIATED ENVIRONMENTAL QUALITY PLAN
MISSION HILL WATERSHED
YANKTON COUNTY, SOUTH DAKOTA

PRINCIPAL ENVIRONMENTAL QUALITY PROBLEMS

Sheet Erosion: Sheet erosion problems exist mainly in the uplands of the watershed. In most areas the problems are not severe. The average annual sheet and rill erosion in the uplands is about 4.4 tons per acre. The highest rate on cropland is 8.8 tons per acre on about 140 acres. Sheet and rill erosion from pasture in the upland area is 2.6 tons per acre annually.

On the level areas south of Mission Hill there is almost no sheet erosion from water on 1,700 acres.

Although 46 percent of the watershed is Class I land, which has few limitations or hazards to crop production, wind erosion occurs when the soil is not adequately covered.

Gully Erosion: One known gully exists in the watershed. The gully head has stabilized at a county road culvert just downstream from the planned floodwater retarding structure but widening and sloughing of the banks is taking place. The gully is the only reach of channel where erosion is active. About 1 acre of land has been voided.

Sediment Deposition: Sediment is deposited on cropland, hayland, wildlife habitat areas, wetlands, yards, gardens, and in road ditches, stream channels, and the Missouri River. This contributes to deterioration of land and water resources. The removal of the sediment from road ditches, culverts, bridges, and channels causes further disturbance of vegetation and the cost adds to local taxes.

Water Quality: Water quality problems in the watershed are those associated with the discharge of pesticides and fertilizers when runoff occurs. Soil particles and organic material are also present in the water and are deposited in downstream areas or in the Missouri River.

Wildlife Habitat Losses: Intensive farming practices reduce available habitat of most kinds of wildlife. There is some tendency to monoculture which reduces value of the land for wildlife purposes.

Many farmers use large machinery, high speed operation, and prefer straight rows with no obstructions, such as weedy rockpiles, trees, and wetlands. The need for efficient operations encourages use of every acre for crop or pasture production. Some species of trees that have been planted for field windbreaks, farmstead and feedlot protection, and wildlife habitat are threatened by disease. About 22 acres are affected.

Potential Loss of Native Woodland and Grassland: The climax vegetation of most of the land resource is grass. A few areas of native trees and native grass still remain but not in an optimum condition. These areas are generally being used for agricultural purposes and changes in the vegetation are taking place. Preservation and enhancement of these areas is desirable.

COMPONENT NEEDS

1. Improve water, land, and air quality by controlling erosion, sedimentation, and other pollutants.

2. Preserve, manage, and enhance an area of native woodland and grassland for an example of native vegetation.

3. Preserve or enhance the beauty of the area and the usefulness of the trees for other purposes such as windbreaks and wildlife habitat.

4. Provide additional habitat for wildlife and enhance existing areas.

ELEMENTS TO MEET COMPONENT NEEDS

1. Additional land treatment practices on the 8,502 acres of the watershed will help to meet the component need of improved land, water, and air quality. The practices include but are not limited to the following: conservation cropping systems, contour farming, terraces, critical area planting, crop residue management, stripcropping, minimum tillage, pasture and hayland management, farmstead and field windbreaks, field borders, grassed waterways, ponds, recreation area improvement, and wildlife habitat management. The estimated cost of installation is $31,200, including technical assistance. Practices could be installed by the landowner with technical assistance provided by the Soil Conservation Service and the Forest Service.

2. Public ownership of a 35-acre tract is an element that would meet the need for conservation of native woodland and grassland. Federal, state, or local units of government or private organizations could acquire this land if funds are available. The estimated cost is $12,250.

3. The removal, disposal, and replacement of 22 acres of diseased or dead trees in the watershed could be accomplished by individual landowners or homeowners. The estimated cost is $23,000. Financial assistance is needed to reach this goal.

4. There are numerous areas in the watershed that are not presently farmed or grazed because of their very small size or inconvenient location. These areas could be permanently set aside and habitat developed for the benefit of wildlife. Other small areas adjacent to wetlands, channels, and existing tree areas could also be developed for wildlife. The estimated cost of scattered small wildlife areas totaling 26 acres is $20,000. The cost includes land, $8,000; fencing, $8,000; seeding, mulching, and fertilizing, $3,000; and tree planting, $1,000. These areas could be developed by federal, state, or local government.

ENVIRONMENTAL EFFECTS

1. Water, land, and air quality
   --Reduce runoff of water with its associated fertilizers, pesticides, and organic matter from 8,502 acres.
   --Reduce sheet and gully erosion by more than 1,500 tons annually.
   --Convert 35 acres of private land to public land resulting in loss of harvestable timber products by public ownership of woodland.
   --Reduce fuel consumption by minimum tillage practices.

2. Areas of natural beauty
   --Change esthetic value of landscape by replacement of individual trees and shelterbelts and by many of the land treatment practices.

3. Biological resources and selected ecosystems
   --Protect two wetlands (4 acres) by land treatment and buffer zones.
   --Convert 22 acres of crop, pasture, and odd areas to wildlife habitat areas.

Part 3

This section shows a display of the four accounts of the selected plan. These accounts include:

1. National Economic Development (NED)
2. Regional Development (RD)
3. Environmental Quality (EQ)
4. Social Well-Being (SWB)

Selected Plan

National Economic Development Account
Mission Hill Watershed, South Dakota

Components	Measures of effects (Average annual dollars) 1/
Beneficial effects:	
A. The value of users of increased output of goods and services.	
1. Flood prevention	$45,600
Total beneficial effects	$45,600

Components	Measures of effects (Average annual dollars) 1/
Adverse effects:	
A. The value of resources required for a plan.	
1. Floodwater retarding structure, grade stabilization structure, and channel work.	
Project installation (structural measures)	$31,530
Project Administration	4,110
OM&R	1,580
Total adverse effects	$37,220
Net beneficial effects	$ 8,380

1/ Amortized for 100 years at 6-7/8 percent interest rate.

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Selected Plan

Regional Development Account
Mission Hill Watershed, South Dakota

Components	Measures of effects (Average annual dollars) 1/ Region 2/	Rest of Nation
A. Income:		
Beneficial effects:		
1. The value of increased output of goods and services to users residing in the region.		
a. Flood prevention	$45,600	-
b. Secondary	$23,900	-
Total beneficial effects	$69,500	-

Components	Measures of effects 1/ (Average annual dollars) Region 2/	Rest of Nation
A. Income:		
Adverse effects		
1. The value of resources contributed from within the region to achieve the outputs.		
a. Floodwater retarding structure, grade stabilization structure, and channel work.		
Project installation (structural measures)	$ 6,860	$24,670
Project administration	50	4,060
OM&R	1,580	-0-
Total adverse effects	$ 8,490	$28,730
Net beneficial effects	$61,010	-$28,730

1/ Amortized for 100 years at 6-7/8 percent interest rate.
2/ A 12-county Planning and Development District.

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Selected Plan

Regional Development Account
Mission Hill Watershed, South Dakota

Components	Measures of effects (Average annual) Region 1/	Rest of Nation
B. Employment		
Beneficial effects:		
1. Increase in the number and types of jobs.		
a. Employment for project construction	9 semi-skilled jobs for 1 year	-
b. Employment for project OM&R	0.3 permanent semi-skilled jobs	-
Total beneficial effects	9 semi-skilled jobs for 1 year	-
	0.3 permanent semi-skilled jobs.	

Components	Measures of effects (Average annual) Region 1/	Rest of Nation
B. Employment		
Adverse effects:		
1. Decrease in number and types of jobs.		
a. Loss in employment in project take area	-	-
Total adverse effects	-	-
Net beneficial effects	9 semi-skilled jobs for 1 year	-
	0.3 permanent semi-skilled jobs	

1/ A 12-county Planning and Development District.

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Selected Plan

Regional Development Account
Mission Hill Watershed, South Dakota

Components	Measures of effects	
	Region 1/	Rest of Nation
C. Population Distribution		
Beneficial effects	Creates 9 semi-skilled jobs for 1 year and 0.3 permanent, semi-skilled jobs. This is in a primarily rural region that has experienced a 5.6 percent reduction in population in the last 10 years. The stabilized income will help to reduce outmigration from the area.	-
Adverse effects	-	-
D. Regional Economic Base and Stability		
Beneficial effects	Provide flood protection to a 1,680-acre flood plain in an area where agriculture is the primary economic base and protection of nine homes and surrounding environment in the town of Mission Hill.	-
	Flood erosion and sediment damages to roads, bridges, channel, hayland, pasture, yards, and gardens will be reduced 75 percent.	-
	The unemployment level for Yankton County in 1970 was 2.7 percent with a special need for supplemental income for 14 percent of those families receiving less than $2,500 annually from sale of agricultural products.	-

1/ A 12-county Planning and Development District

Selected Plan

Environmental Quality Account
Mission Hill Watershed, South Dakota

Components	Measures of effects
Beneficial and Adverse effects:	
A. Areas of natural beauty.	1. Reduce sediment damage to farm ponds, wetlands, cropland, and pasture.
	2. The natural resources of the area will be enhanced through soil building techniques to be applied.
B. Quality considerations of water, land, and air resources.	1. Reduce sediment production 1,500 tons annually.
	2. Reduce downstream sediment damages to roads, bridges, and channel 67 percent.
	3. Reduce floodwater damage on 1,680 acres of cropland and pasture.
	4. Runoff of water from cropland and pasture will be decreased.
	5. About 0.6 mile of ephemeral stream channel will be temporarily inundated by the 7-acre sediment pool and will eventually fill with sediment.
	6. There will be an increase in noise level and in dusty conditions during construction.
	7. Sediment concentration in the water leaving the watershed will be reduced from 510 p/m to 94 p/m.
	8. There will be an annual decrease of 36 tons of sediment leaving the watershed.

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Components	Measures of effects
C. Biological resources and selected ecosystems.	1. There will be a change of 1.2 acres of woody habitat to herbaceous vegetation which serves to diversify habitat along the Missouri River.
	2. There will be a net increase of 49 acres of herbaceous cover.
	3. There will be a net increase of 1 acre of woody cover.
	4. There will be more and better wildlife habitat by increased and improved vegetative cover on the watershed caused by land treatment. This includes grassed waterways, turnrows used in contour farming and terraces, tree planting, pasture and hayland management, conservation cropping systems, and farm ponds.
	5. Agricultural and upland wildlife use of 7 acres of pasture in the sediment pool will be reduced.
	6. Agricultural and upland wildlife use of up to 34 acres of cropland and 59 acres of pasture in the flood pool will be periodically interrupted by floodwaters.
	7. There will be a temporary loss of 2.2 acres of woody habitat because of channel construction and until replacement is made after completion of construction.
	8. There will be a temporary loss of use during construction by agriculture and wildlife of 105 acres of cropland and pasture.
	9. There will be a temporary loss of use by wildlife during construction of 16 acres of herbaceous habitat.
D. Irreversible or irretrievable commitments.	1. Agricultural and upland wildlife use of cropland and grassland will be reduced in 7 acres of the sediment pool. Flooding of 59 acres of grassland and 34 acres of cropland in the flood pool

Components	Measures of effects
D. Irreversible or irretrievable commitments (continued)	will periodically interrupt upland wildlife and agricultural use of these areas. An estimated 0.6 mile of intermittent stream will be filled by sediment. Two acres of pasture and 23 acres of cropland will be used for the floodwater retarding structure and associated spillway. It will be usable by wildlife and for limited grazing by livestock. Twenty-five acres of cropland will be committed for purposes of the channel, maintenance berm, and spoil area. This will be usable by wildlife and for limited grazing by livestock.
E. Other environmental effects.	1. There will be reduced flood damage to nine homes and other yards, gardens, fences, roads, and bridges in the town of Mission Hill. Monetary benefits will provide a better life for owners and operators of farms in the benefit area, improve the economy, and help to improve the physical appearance of the area.

Selected Plan

Social Well-Being Account
Mission Hill Watershed, South Dakota

Components	Measures of effects
Beneficial and Adverse effects:	
A. Real income distribution.	1. Create 9 man-years of semi-skilled employment during project construction and 0.3 permanent semi-skilled man-years of employment for annual operation and maintenance of project.
	2. Create regional income benefits of $69,500 annually. Regional costs are $8,490. The income distribution and cost to the project beneficiaries are considered representative of the rural population of Yankton County which includes 20 percent of the families with incomes of less than $3,000; 50 percent, $3,000 to $10,000; and 30 percent over $10,000.
B. Life, health, and safety.	1. Provide 1 percent chance level of flood protection for nine homes in Mission Hill.

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WATERSHED WORK PLAN AGREEMENT

between the

Mission Hill Watershed District
Local Organization

Yankton County Conservation District
Local Organization

Town of Mission Hill
Local Organization

(hereinafter referred to as the Sponsoring Local Organization)

State of South Dakota

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Mission Hill Watershed, State of South Dakota, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666),as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service, a mutually satisfactory plan for works of improvement for the Mission Hill Watershed, State of South Dakota, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 5 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire, with other than PL-566 funds, such landrights as will be needed in connection with the works of improvement. (Estimated Cost $99,750).

2. The sponsoring local organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisitions Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the sponsoring local organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs 1/ (dollars)
Relocation Payments	21	79	0

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
All structural measures	0	100	330,300

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Engineering Cost (dollars)
All structural measures	0	100	28,020

1/ Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentage shown.

6. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be $700 and $58,940, respectively.

7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party inititates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties. An amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsors having specific responsibilities for the particular structural measure involved.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Mission Hill Watershed District
Local Organization

By Howard E. Nielsen

Title Chairman

Yankton, SD 57078
Address Zip Code

Date April 30, 1975

The signing of this agreement was authorized by a resolution of the governing body of the Mission Hill Watershed Board of Managers
Local Organization

adopted at a meeting held on April 30, 1975

Julia E. Nielsen
Secretary, Local Organization

508 E. 21st 57078
Address Zip Code

Date April 30, 1975

Yankton County Conservation District
Local Organization

By [illegible]

Title Chairman

Volin, SD 57072
Address Zip Code

Date May 5, 1975

The signing of this agreement was authorized by a resolution of the governing body of the Yankton County Conservation District
Local Organization

adopted at a meeting held on May 5, 1975

Tina Christensen
Secretary, Local Organization

Utica, SD 57067
Address Zip Code

Date May 5, 1975

Town of Mission Hill
Local Organization

By Sylv Nelson

Title CHAIRMAN BOARD OF TRUSTEES

Mission Hill S. Dak 57046
Address Zip Code

Date 7-8-75

The signing of this agreement was authorized by a resolution of the governing body of the BOARD OF TRUSTEES
Local Organization

adopted at a meeting held on June 8 - 1975

Kay Magnuson by D.D
Secretary, Local Organization

Mission Hill 57046
Address Zip Code

Date 7-8-75

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

[signature]
State Conservationist

7/16/75
Date

WATERSHED WORK PLAN

MISSION HILL WATERSHED

Yankton County, South Dakota

July 1974

SUMMARY OF PLAN

Mission Hill Watershed is located in southeastern Yankton County, South Dakota. It contains about 8,502 acres, or 13.3 square miles. The watershed is sponsored by the Yankton County Conservation District, the Mission Hill Watershed District, and the town of Mission Hill.

Flood damages to agricultural lands occur nearly every year from summer storms or from snowmelt. Damage to homes in Mission Hill occurs on the average of once every 5 or 6 years.

Land treatment measures are the basic elements of watershed projects. They will be planned, installed, and maintained on privately owned land by the landowners and operators. Emphasis will be given to the land treatment that will provide a measurable reduction of erosion and sediment rates and keep surface runoff at a minimum while maintaining a high level of production. The cost of land treatment measures to funds other than PL 566 is $15,000.

The land treatment measures, together with a combination of one floodwater retarding structure, about 3.8 miles of channel work, and one grade stabilization structure will reduce floodwater damages to 1,680 acres in the agricultural area. Nine homes in Mission Hill will be protected from the 100-year frequency flood. Damage to roads, bridges, fences, and other agricultural property will also be reduced.

Erosion rates within the watershed will be reduced 1,500 tons annually. Sediment damages to roads, bridges, channel, hayland, pasture, yards, and gardens will be reduced 75 percent. The quality of the water leaving the watershed will be improved by an estimated reduction of sediment concentration in the water from 510 p/m to 94 p/m. Sediment leaving the watershed will decrease from 125 tons annually without the project to about 89 tons annually with the project.

The 77.1 acre-foot sediment pool is expected to fill in 100 years and cover 0.6 mile of ephemeral stream.

The installation of the structural measures will result in the loss of 58 acres of cropland. There will be a gain of 1 acre of woody habitat, 8 acres of pasture, and 49 acres of herbaceous habitat.

It is estimated that 5 years will be required to apply the required land treatment measures and to install the structural measures.

The total installation cost of the structural measures is $517,710. The PL 566 share is $417,260, or 81 percent, and includes construction cost $330,300, engineering services cost of $28,020, and administrative cost of $58,940. The share of structural measures other than PL 566 is $100,450, or 19 percent. This includes $99,750 for landrights and $700 for administrative cost.

The total project cost is $541,110. The PL 566 share is $425,660, or 79 percent. Costs other than PL 566 are $115,450, or 21 percent. The average annual project costs are $37,220. This includes $1,580 annual operation and maintenance costs. The average annual project benefits are $69,500. The resulting benefit-cost ratio is 1.9 to 1.0.

The Mission Hill Watershed District has requested the Soil Conservation Service to do the contracting for structural measures. The watershed district will be responsible for operation and maintenance of structural measures.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical Data

Mission Hill Watershed is in southeastern Yankton County near the southeastern corner of South Dakota. The watershed is about 11 miles long with a maximum width of about 2 miles. The watershed has an area of 8,502 acres, or 13.3 square miles.

The population of the watershed is 279. One hundred and sixty-one persons live in Mission Hill, the only town within the watershed boundaries. Yankton, the county seat of Yankton County, has a population of 11,919 and is 9 miles to the southwest of Mission Hill. Vermillion, population 9,128, is 16 miles southeast. 1/

The watershed is in the Missouri Water Resource Region 10 and the Missouri-Big Sioux Subregion 17. The watershed is similar to much of the subregion in eastern South Dakota with low rolling hills on glacial plains with frequent flooding of lowland agricultural lands. Rainfall is above the region and subregion averages but weather patterns are similar.

Farming is the main land use in the watershed. The ratio of cultivated cropland to other uses is higher than either the region or subregion. The principal problem is the flooding of cropland adjacent to the stream channel. The main flooded area is on the broad Missouri River terrace south of Mission Hill and north of state highway 50. An average of 536 acres are

1/ Watershed population is estimated. Other population data is from the "1970 Census of Population" U.S. Department of Commerce, Bureau of Census.

flooded annually. The 100-year frequency storm floods about 1,680 acres of which 110 acres are outside the watershed.

Sheet erosion and runoff are problems in the watershed and contribute to downstream flooding and sediment deposition. Sediment deposition along about 2.4 miles of channel north of state highway 50 has reduced the channel capacity and increased flooding frequency. One 48-inch culvert was completely covered by sediment in about 16 years.

Land treatment is needed to reduce sheet erosion and runoff from cropland in the watershed. Improved management is needed on much of the pastureland.

Erosion rates exceed acceptable limits for sustained production on about 140 acres of cropland above the floodwater retarding structure.

Most of the drainage area above the floodwater retarding structure is in the Houdek-Prosper soil association and a small part in the Ethan-Clarno-Betts soil association.[1/] These soils are mainly deep, loamy, well and moderately well drained developed on glacial till. Areas on the flood plain which are damaged and will be benefited are principally in the Albaton-Haynie soil association. The Albaton is a deep, poorly drained soil with very slow to slow permeability. The Haynie is a deep, silty, well to moderately well drained flood plain soil with moderate permeability.

Forty-six percent of the watershed is in Land Capability Class I, 39 percent in Class II, 12 percent in Class III, and 2 percent in Class IV. The remaining 1 percent is Class V.[2/]

1/ South Dakota Agricultural Experiment Station Information Series No. 3, January 1971.

2/ Klingbiel, A.A., and Montgomery, P.H., "1961 Land Classification" USDA Handbook 210, 21 pp., Illus.

Northwest of the town of Mission Hill the watershed is in low, rolling, glacial moraine hills. South of the town is a Missouri River terrace, about 10 feet above the Missouri River flood plain.

The upper rolling hills area is Late Wisconsin age glacial till. The bedrock underlying the till is Cretaceous age shales, limestones, and marls of the Carlile and Niobrara Formations. The contact between the Carlile and the younger Niobrara lies somewhere just north of Mission Hill. The Missouri River terrace materials in the southern part of the watershed are fine sands and silt overlying Wisconsin age outwash. Bedrock under the terrace is the Carlile Formation. The creek crosses the terrace and enters an abandoned meander channel on the lower flood plain. It follows this channel to the Missouri River.

The topography is low rolling hills in the north half of the watershed. The southern portion is flat with slight undulations. The high elevation, 1,400 feet above mean sea level, is at the extreme northern end. The elevation at the mouth of the watershed is 1,154 feet above mean sea level. The elevation of the main flooded areas in the watershed is between elevations 1,166 and 1,170.

The average annual precipitation is about 23 inches. Extremes at Yankton, the nearest gage, range from 13 inches to more than 38 inches. Most of the precipitation occurs during the summer months from high intensity, short duration rainstorms. The months of April through September account for more than 75 percent of the total precipitation.

Abrupt changes in weather are common. These changes are often caused by warm,moist air from the south meeting cold, dry air from the north. This

combination often produces severe weather with intense precipitation. The maximum recorded 24-hour rainfall at Yankton is 7.52 inches. This occurred July 14, 1900. The seasonal snowfall average is about 30 inches.

The average annual temperature is 48 degrees. The average January and July temperatures are 18 and 76 degrees, respectively. Extreme temperatures in the area range from more than 110 degrees above zero to nearly 40 degrees below zero. The average frost-free period is 161 days. 1/

The only mineral resources in the watershed are sand and gravel. There are gravel pits near the watershed in the terrace alluviums adjacent to the Missouri River. Sands and gravels are mined from remnants of outwash or terrace deposits in the till within a few miles of the watershed. This material is probably present in the watershed but remains undeveloped.

Ground water is available from shallow alluvial and glacial aquifers and deeper Cretaceous artesian aquifers. Flowing artesian wells tapping the Dakota Aquifer are present on the terrace areas in the watershed.

The waters of both aquifers are of poor quality for domestic, livestock, and agricultural uses, due to their high concentrations of sulfates, calcium, and magnesium ions. High mineral content is reflected in the combination of total hardness, expressed as calcium carbonate (CaC_{O_3}) and total solids. High alkalinity is also indicated by the values for total alkalinity and bicarbonates (HCO_3).

1/ All precipitation and temperature data taken from publications of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

The following data are chemical analyses available from wells in, or adjacent to, the Mission Hill Watershed.

	Artesian	Alluvial	
	Old Mission Hill well 1937 1/	New Mission Hill well 2/	Terrace well 3/ Adjacent to Watershed
Alkalinity, Total	130.0 p/m	325.0 p/m	212.0 p/m
pH	7.3	7.2	-
Total Hardness ($CaCO_3$)	1,221.0 p/m	874.0 p/m	696.0 p/m
Calcium (Ca)	377.0 p/m	284.0 p/m	188.0 p/m
Magnesium (Mg)	67.0 p/m	37.0 p/m	55.0 p/m
Bicarbonates (HCO_3)	146.0 p/m	387.0 p/m	-
Sulfates (SO_4)	1,137.0 p/m	712.0 p/m	400.0 p/m
Iron (Fe)	3.2 p/m	5.6 p/m	trace
Manganese (Mn)	0.2 p/m	1.9 p/m	1.1 p/m
Sodium (Na)	106.0 p/m	75.0 p/m	43.0 p/m
Potassium (K)	20.8 p/m	15.3 p/m	-
Chloride (Cl)	120.0 p/m	14.0 p/m	31.0 p/m
Fluoride (F)	3.0 p/m	0.5 p/m	0.3 p/m
Nitrates (No_3)	0	0	0
Total Solids	2,036.0 p/m	1,534.0 p/m	1,138.0 p/m

1/ "South Dakota Public Waters Supply Data" South Dakota Department of Health, October 1966.
2/ On file - South Dakota Department of Environmental Protection.
3/ Jorgensen, D.G., "1966 Geology and Shallow Ground Water Resources of the Missing Valley Between North Sioux City and Yankton, South Dakota" South Dakota Geological Survey - Report of Investigation No. 86.

Water quality information available on the till aquifers to the east, in Clay County, indicates they generally contain very hard, slightly saline water with iron, manganese, sulfate and dissolved solids in excess of the U.S. Public Health Service (1962) standards. These aquifers may be comparable to the till aquifers in the Mission Hill Watershed.

The use of a particular ground water source generally indicates what is available and not necessarily a good quality source.

Domestic and livestock water is supplied by wells. There are no problems pertaining to ground water recharge and water quality management.

The land use in the watershed, with the exception of the town of Mission Hill, is devoted to agriculture. Eighty-five percent, or 7,238 acres, of the total land is cropland. There are 574 acres of grassland and 120 acres of native woodland. The remaining 570 acres include the town, roads and road ditches, farmsteads and windbreaks, feedlots and various minor uses.

The area subject to flooding is 91 percent cropland. Pasture, woodland, and miscellaneous uses comprise the remainder.

The two areas considered "most natural" are a woody plant community of about 35 acres just southwest of Mission Hill and a 200-foot wide strip of deciduous woodland along the Missouri River. Both sites have secondary plant succession due to disturbances by man, animals, and fire. Some secondary succession is taking place along the Missouri River because deposition of sediment from Missouri River flooding has been virtually stopped.

A deciduous tree and shrub community, with openings and borders of true prairie, occur on the 35-acre site. Predominant trees are green ash, American elm, and boxelder; shrubs are American plum, chokecherry, currant, smooth sumac, poison ivy, and western snowberry. Kentucky bluegrass and smooth bromegrass are invading the grassland. The Missouri River site is dominated by plains cottonwood, peachleaf willow, and green ash, with a sparse understory of American plum, chokecherry, some broad-leaved forbs, and a light scattering of grass.

The entire stream is ephemeral (E), flowing only during spring snowmelt runoff and rainstorms. It has a stream gradient of about 25 feet per mile. Agricultural use of the watershed has caused changes in the channel characteristics from the head of the watershed to the town of Mission Hill. Other modifications along the channel upstream from town are at bridge crossings.

Southeast of the town of Mission Hill much of the channel is man-modified (M) to the point where it enters the abandoned meander channel at station 385+70. The channel was aligned to run parallel with the railroad probably when the railroad was built. This alignment continues to the county road, 1 mile east of Mission Hill. Modifications and alignment changes were made at all bridges downstream. About 1915, a large capstan plow was used to clean and deepen the channel between stations 239+90 and 385+70. In 1952, several reaches in the same area were widened and deepened to release trapped floodwater. About 1.5 miles of channel was affected at that time. Blasting was used to clear sediment from the channel below state highway 50.

Trees along about 800 feet of channel were removed downstream from station 320+90 in 1967.

At the present time, water from runoff remains ponded for short periods of time in the channel from a point about 1 mile north of state highway 50 and upstream for a distance of 1.2 miles. Normally this reach is dry. Stream gradient from just east of Mission Hill to the oxbow is nearly level.

The abandoned meander channel is classified natural (N). Agricultural use along the channel has changed its characteristics. Gradient in the oxbow is less than 5 feet per mile.

The stream is in the intermittent stream category according to "Water Quality Standards for the Surface Waters of South Dakota." 1/ By the standard's definition, when streams exhibit zero flows, they automatically revert to the intermittent stream category.

1/ Adopted by the South Dakota Committee on Water Pollution, Feb. 16, 1967.

There are no stream gages in the watershed nor is surface water quality data available.

Two potholes of about 2 acres each are at the extreme northern end and are the only wetlands in the watershed. They are classified Type III as defined in "Wetlands of the United States" Fish and Wildlife Service, Circular C-39.

Economic Data

All the land in the watershed is privately owned except for county roads and streets in Mission Hill. The majority of residents living in Mission Hill own their homes.

Using county census data, which should be representative of the watershed, 44 percent of the farmers own all the land they farm while another 39 percent own at least a portion of the land farmed. 1/

County census data indicate that livestock sales contribute more than 75 percent of the farm income. 1/ Most of the corn, oats, and alfalfa raised on the farm is fed to livestock.

An estimated 80 people own land in the watershed. However, only 31 farmers live in the watershed with a third of the farmers located in the benefited area. The average size of the farms is 275 acres.

The primary crops produced are corn, alfalfa-brome, oats, and some soybeans. The estimated flood-free crop yields per acre for the problem area under "future without project condition" are: corn, 95 bushels per acre; corn silage, 19 tons per acre; alfalfa-brome mixture, 5.5 tons per acre; and soybeans, 45 bushels per acre. The average crop yields for the entire watershed under "future without

1/ "1969 Census of Agriculture" U.S. Department of Commerce.

project conditions" are: corn, 85 bushels per acre; corn silage, 17 tons per acre; alfalfa-brome mixture, 4 tons per acre; and soybeans, 35 bushels per acre.

The value of cropland in the upland is $250 to $375 per acre. Under present conditions, cropland on the flood plain averages about $325 per acre. The average value of the homes in Mission Hill subject to flooding is about $5,000.

The watershed is served by U.S. Interstate Highway 29, which is 20 miles east, and U.S. Highway 81, which is 6 miles west. Both U.S. Highways are accessible to the watershed by several east-west hard-surfaced roads, including State Highway 50. The area is also served by the Burlington-Northern Railroad and by the Chicago, Milwaukee, St. Paul, and Pacific Railroad. Sioux Falls and Sioux City, 60 miles away, and nearby Yankton, provide market alternatives for sale of livestock. Grain is marketed in Mission Hill and several other nearby towns. Some alfalfa is sold to alfalfa processing plants a few miles from the watershed.

The watershed is located in a stable environment assuming that the county statistical data is representative. The unemployment rate for Yankton County in 1970 was 2.7 percent. The rural farm unemployment rate was 1.7 percent for Yankton County. 1/

The average market value for all agricultural products sold in the county was $22,886 per farm. Four percent of the farmers hired additional farm labor for more than 150 days. Thirty-two percent of the farmers received income from off-farm sources. 2/ This data is probably representative of the watershed.

1/ "1970 Census of Population" U.S. Department of Commerce.
2/ "1969 Census of Agriculture U.S. Department of Commerce.

Because there is no opportunity for off-farm employment in the watershed, part-time jobs are sought in Yankton, Vermillion, and other nearby towns.

The following table compares the median earnings of several groups of people in the state and in Yankton County. The source of the data is the "1970 Census of Population," Bureau of Census, U.S. Department of Commerce.

	State	Yankton County
Professional, Managerial	$8,467	$8,955
Farmers and Farm Managers	4,812	4,575
Labor, Except Farm	3,487	1,535
Farm Labor	1,902	3,145

Although many residents of the watershed are dependent on income from agricultural sources, new programs are being enacted to provide improved economic as well as social conditions in the area. Examples of such programs are the multicounty Lower James Resource Conservation and Development Project and the Third Planning and Development District.

Fish and Wildlife Resources

Significant wildlife species in the watershed are white-tailed deer, pheasant, bobwhite, gray partridge, cottontail, fox squirrel, and mourning dove. Waterfowl make limited use of the area during the spring and fall migrations. There are also jackrabbit, raccoon, fox, badger, skunk, and other wildlife.

Brushy draws, vegetated fence rows, road ditches, waterways, field and farmstead windbreaks, and other areas currently provide permanent habitat for wildlife within the watershed.

The floodwater retarding site is located in heavily grazed pasture and cropland and is not used by most kinds of wildlife.

Reach IV provides little cover for wildlife since it is mainly heavily grazed pasture and some cropland.

Reach III through Mission Hill contains grassy areas and trees planted by homeowners. This reach provides habitat for squirrel, cottontail, mourning dove, and songbirds.

Reaches I and II have a variety of habitat usable by most of the species listed. About 5 acres of herbaceous habitat occur along the proposed channel. A total of about 140 acres of trees in 14 farmstead shelterbelts and in ribbons along the oxbow and the Missouri River occur in that part of the watershed adjacent to the channel in Reaches I and II.

Two Type III potholes of 2 acres each exist in the watershed. They collect runoff from the spring snowmelt or heavy rains. They are usually dry during the summer.

There are no fish within the watershed. All land is in private ownership except public roads.

Recreational Resources

Recreational activities in the watershed are limited to hunting and trapping. There are no fishing opportunities within the watershed. Some fishing is provided by the James and Missouri Rivers adjacent to the watershed. Hunting of upland game bird, waterfowl, deer, rabbit, and squirrel provides seasonal recreation. Trapping furbearers provides some income and recreation opportunities.

Water-based recreation in the watershed is limited to the "old swimming hole" in the Mission Hill town park. Sediment and algal bloom reduce the water quality in the pond. Lewis and Clark Lake on the Missouri River, 4 miles west of Yankton, is the main recreational lake in the area. Boating, fishing, swimming, and camping are all available at the lake.

Archeological and Historical Values and Unique Scenic Areas

There are no sites in the watershed listed in the "National Register of Historic Places," nor are any historic sites on record with the Director of the South Dak Historical Society. There are no known archeological or scientific sites in the watershed. The State Historical Preservation Officer and the State Archeological Commissioner have been consulted.

Soil, Water, and Plant Management Status

There is no significant trend toward change in land use; however future market conditions may influence decisions for land use. Farmers in the flood plain are reluctant to use fertilizers and proper management practices for optimum yield because of the high flood hazard. The land treatment program is lagging in the flood plain area. Conservation practices are needed on about 70 percent of the watershed for the conservation of soil and water, and use within its capability.

The Yankton County Conservation District is active in conservation programs which affect the watershed. It is on record as supporting land use laws and shifts in land use to reduce erosion. It actively promotes conservation farming and advertises conservation with paid radio and newspaper spots. The district has one full-time employee to promote conservation through district programs such as conservation tours, high school awards, speech contest, and to assist in the Soil Conservation Service field offices.

There are 25 cooperators in the watershed and 18 basic farm plans. About 59 percent of the conservation practices needed to reduce runoff and control erosion on cropland have been applied in the upland. Most of the pasture and hayland needs better management for increased production. Seventy-eight percent of the watershed is covered by district cooperator agreements. There are 2,154 acres of cropland, 321 acres of pasture, and 65 acres of woodland that are considered to be adequately treated.

Yankton County is included in the Lower James Resource Conservation and Development Project. The conservation district has requested and received revenue sharing funds from the county to continue its conservation work.

The area is now protected by a rural fire district. Equipment procurement, fire training, and fire prevention education will continue to be developed by the South Dakota State Forester cooperating with the Forest Service through the Cooperative Forest Fire Control Program. Adequate watershed protection can be achieved through this program without acceleration.

Irrigation

There are about 130 acres of irrigation in the watershed at this time. There is potential for additional irrigation on the level lands south of Mission Hill. Wells in the Missouri River alluvium could provide adequate quantities of suitable quality water. Soils are the Albaton-Haynie and the Haynie-Sarpy associations. These soils are suitable for irrigation with few hazards. Corn, soybeans, and alfalfa are the principal crops and would be easily adapted to irrigation. Interest in irrigation development is increasing in the immediate area of the watershed.

Municipal and Industrial Water

The town of Mission Hill has a water system supplied by a shallow well in alluvium which is adequate for the present and near future needs of the town. There is no demand for industrial water at this time.

Recreation

There are no water-based recreation facilities within the watershed with the exception of the town's "swimming pond" which is fed by artesian flow. Boating, fishing, swimming, and camping facilities are available within 15 miles of Mission Hill at Lewis and Clark Lake. The Missouri River provides fishing and limited boating near the outlet end of the watershed. Because of the excellent existing facilities at Lewis and Clark Lake, and the relatively stable population, there is limited interest in future development of recreational resources.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land Treatment

Wind and water erosion of organic matter and topsoil in the uplands has reduced soil fertility and productive capacity. A 5-ton per acre annual loss is that loss which most soils can tolerate without a loss of productive capacity. There are approximately 225 acres above Reach II which have soil losses computed as ranging from 5 to 9 tons per acre annually. The loss of agricultura chemicals including fertilizers, insecticides, and herbicides is closely associated with sediment production. Phosphorus is fixed tc the soil particle and little leaves the field except with the sediment. Much less nitrogen moves with sediment. Certain insecticides and herbicides also attach to soil particle especially clay colloids, and move into the stream system. Soils need to be protected with conservation measures such as conservation cropping systems,

contour farming, crop residue management, grassed waterways, stripcropping, terraces, pasture and hayland management, and tree plantings.

Floodwater Damage

The flood area is divided into four reaches. (See project map.) Reach IV is between the proposed floodwater retarding structure and the town of Mission Hill. Floodwaters in this reach have high velocities that overtop and wash out roads, flood pastures and cropland, damage crops, and deposit debris on the land. This flood plain is narrow and the duration of flood flows is generally short.

Reach III is the area through the town of Mission Hill. The high velocity flows from above cause damage to homes in Mission Hill on the average of once every 5 or 6 years. Nine homes, with an average value of $5,000, are subject to flooding from the 100-year flood. Floodwaters from intense summer storms overflow the channel, overtop roads and bridges, and damage homes, garages, yards, gardens, fences, and other property. Sediment deposited on the flood plain has reduced the channel and bridge capacities. Other debris is also scattered on the flood plain. There is also a possibility of loss of life. Floods from snowmelt runoff in Mission Hill are usually less intense and damages are generally restricted to the overtopping of roads and bridges and flooding of yards.

Reach II is from Mission Hill downstream to the Chicago, Milwaukee, St. Paul and Pacific Railroad. This is the reach where the most serious agricultural damages occur. Some flooding occurs nearly every year on cropland as a result of runoff from summer storms. These storms usually occur in May or June. Sometimes two or more storms each year add to the flooding problems. The depth of flooding is normally shallow but may be several feet in some

places. The duration of flooding is often several weeks and will last longer in some areas when followed by above normal precipitation. The long duration of flooding is a result of inadequate channel capacity. The channel capacity has been continually decreasing because of sediment deposition, encroachment by willows, and farming operations.

Wind and waterborne sediments have been deposited along most of the length of the existing channel in Reaches I and II. This sediment deposition, along with willows growing in the channel and downstream farming operations in Reach I, has retarded flows even more. At South Dakota State Highway No. 50 in Reach I, a culvert about 4 feet in diameter is filled with sediment as is the channel both above and below this point. Flows presently go through a box culvert at a higher elevation.

Problems also result from snowmelt runoff in Reach II. This usually occurs in March or early April and the flooding may last for several weeks. In severe cases some land remains wet for much of the season when these floods are followed by unusual spring and summer rains. When the floods occur before the normal planting dates, seeding is usually delayed several weeks and it sometimes becomes too late to plant. Floods occurring later in the season either damage or kill the crops or prohibit cultivation and proper care.

The frequent flooding limits the choice of crops that can be grown to those that are most tolerant of flooding. This makes it more difficult to properly manage the land. The floodwaters also spread weed seeds and hinder control by either cultivation or herbicides. There is a constant threat of livestock disease transported by the floodwaters. Several farmsteads are isolated by large floods and additional travel is necessary. The flood plain is poorly defined in this area.

When snow or debris has reduced the channel capacity, or during extremely high flows, floodwaters overflow the divide and leave the watershed.

Flooding in Reach I is generally infrequent although a few small areas at the upper end flood almost annually. The flooding is limited to cropland, pasture, and some woodland. There are few limitations of use. Since the channel capacity is restricted due to sediment, there also exists a potential for flooding of large areas from intense storms in the immediate area.

A severe flood in the watershed occurred on May 22, 1966. On that day, from 2½ to 5½ inches of rain fell within a few hours. Ground cover was at a minimum since most of the cropland was in a near fallow condition. This probably increased the runoff from the storm. Floodwaters came rushing out of the hills overtopping and washing out a road in Reach IV. Nine homes in Mission Hill sustained severe damages to the structures and contents. These homes received about $10,000 damages from this flood. One of these homes was moved off its foundation from the force of the water. Several garages and other buildings were flooded as were yards and gardens. An auto repair shop had $1,700 damage. Four families were rescued from their homes by boat. Roads were overtopped and damaged. After rampaging through Mission Hill, the floodwaters reached the agricultural area identified as Reach II where they spread out inundating 855 acres. Nearly all the crop in that area was destroyed. Some of the area was reseeded with a late crop and some of the area produced no harvest at all in 1966. In addition, debris was scattered on the flood plain. The runoff from the storm that caused the flood in this agricultural area has about an 18 percent chance of occurring in any year.

Most of the water remained in Reach II but some moved slowly downstream into Reach I. Only minor flooding occurred in Reach I.

The principal crops grown in the flood hazard area are corn, alfalfa, oats, and soybeans. Oats is used primarily as a companion crop with alfalfa. Most of the corn, alfalfa, and oats is fed to livestock. About 91 percent of the flood plain is cropland.

About 21 landowners have land in the flood plain. Ten of the operating units are located in the flood plain. The average size of the operating unit is 270 acres. Land values average $325 per acre.

The average annual flood damages to crops and pastures are $37,700. Damages to fences, farm equipment, and other farm losses are $4,100. Roads, bridges, and railroads have annual damages of $1,500. Average annual damages to homes in Mission Hill are $900. Annual sediment damages are $2,530 and indirect damages are $4,670 for a total average annual damage of $51,400. (See table 5.) The total area subject to flooding from a 100-year frequency storm is 1,680 acres of which 110 acres are outside the watershed. Based on past trends and continued accumulations of sediments, and other blockage of the existing channel, flood conditions will continue to become more severe in Reaches II and III.

Erosion Damage

Gentle slopes throughout the watershed limit erosion and associated problems. Sheet erosion is low to moderate in most areas. There is almost no sheet erosion due to water on about 1,700 acres south of Mission Hill. Sediment accumulates over much of the flood plain in Reaches I and II. The average

annual sheet and rill erosion rate for cropland in the upland is 4.4 tons per acre. The highest rate calculated on cropland on the upland is 8.8 tons per acre. Sheet and rill erosion from pasture in the upland area is calculated at 2.6 tons per acre annually.

The road ditches in the watershed are well grassed and generally act as sediment traps. One gully was observed in the watershed. The gully head has stabilized at a county road culvert just downstream from the planned floodwater retarding structure. The gully is the only reach of channel where erosion is active. Gully, road, streambank and channel erosion amounts to less than 5 percent of the total erosion in the watershed.

The flood plain soils are generally more susceptible to wind erosion than the upland soils.

There are no critical sediment source areas in the watershed.

Sediment Damage

Sediment deposition occurs in conjunction with flooding in the watershed on about 1,570 acres. About 536 acres receive sediment deposition on an average annual basis. The type of sediment deposited on cropland is fine grained and does no permanent damage to the land. Damage to crops is only during the flooding. Sediment increases damages to hay crops because particles of sediment adhering to the hay make it less desirable for feeding livestock. The total area of hayland and pasture damage from sediment is 297 acres. The average annual damage is $880.

Sediment derived from sheet erosion is deposited in two areas as shown on the project map. Area A receives large quantities of sediment which is deposited on pasture, hayland, and residential lawns. The town area is

about 25 acres, including 4 acres of lawn and garden which receive about $80 average annual damage. Area B receives sediment damage mainly to the channel where filling is increasing flooding frequency. Sediment has filled bridges and culverts. One 4-foot culvert has been buried and at least 6 feet of sediment has accumulated under some bridges.

Channel blockage was blasted open in the past. This was done during severe flooding and resulted in floodwaters flowing through the breach carrying large amounts of sediment to the Missouri River. Since the blasting, wind and waterborne sediment has blocked the channel causing flood problems again. The average annual damages to roads, bridges, and channel are $1,570. These damages are shown in table 5. There are no downstream reservoirs.

About 125 tons of sediment leave the watershed on an average annual basis. Much of this is from erosion and runoff south of state highway 50. Sediment leaving the Mission Hill Watershed is dispersed in the Missouri River. The average annual flow in the Missouri River, measured at Yankton for the period 1955 to 1969, was 15,787,000 acre-feet, according to information received from the Corps of Engineers. This compared with a 50 percent chance annual yield of 180 acre-feet from Mission Hill Watershed. Using the estimated 50 percent chance yield, the sediment concentration in the water leaving the watershed is calculated to be about 510 p/m. Sediment concentration in the Missouri River at Yankton averaged 89 p/m between 1955 and 1969, according to information received from the Corps of Engineers.

The attachment of pesticides and fixation of phosphorus, and, to a lesser degree, nitrogen, can make clay size sediment a severe contaminant of surface waters. Monitoring of water has not been done so it is not known what magnitude of agricultural contaminants leave the watershed. It is assumed that phosphorus

and pesticides are attached to sediment whereas most nitrogen is in solution in the water. Samples taken of Missouri River water at Yankton, South Dakota, and Omaha, Nebraska, in 1966, showed no measurable level of pesticides. 1/

Drainage

There are no known areas of high water table which require drainage. Wet conditions occur for extended periods because of channel blocks. The fine grained mixture of the affected soils requires long periods of drying before farming operations can be resumed.

Fish and Wildlife

Sediment deposition in the two Type III wetlands and other water storage areas has reduced the quality and quantity of available wildlife habitat. These wetlands are temporary and need to be developed to provide maximum utilization by wildlife. Frequent flooding along the channel is a threat to nesting game birds. There are no fisheries within the watershed. There are no known pollution problems caused by excess nutrients or pesticides.

Economic and Social

County census statistics reveal that 14 percent of the farmers receive less than $2,500 annually from the sale of agricultural products. 2/ These farming units are considered low income producing units. Another indicator of the need to increase farm income is shown by comparing the mean income of farm families, which was $3,895 in 1969, compared with over $8,000 for self-employed or regular wage earners working in town. 3/ These data are considered

1/ "Pesticides in Our National Waters" R.S. Green, C.G. Gunnerson, and J.J. Lichtenberg, "Agriculture and the Quality of Our Environment."
2/ "1969 Census of Agriculture" U.S. Department of Commerce.
3/ "1970 Census of Population" U.S. Department of Commerce.

representative of the watershed although published data is not available to substantiate this assumption.

Only 4 percent of the farmers in the county hire more than 1½ man-years of outside help based on the 1969 census data.

The area where the watershed is located is not considered to be economically depressed. However, some people in the watershed need to improve their economic and social environment. Also, census data suggest a need to improve the alternatives for off-farm employment, especially for women seeking such employment.

PROJECTS OF OTHER AGENCIES

In the past, part of the Mission Hill flood plain has been flooded by the Missouri River. However, with the completion of the Corps of Engineers dams on the Missouri River, this threat has been reduced. The 20-year frequency elevation (1,158 feet above mean sea level) of the Missouri River would back water into the existing outlet channel of the Mission Hill Watershed. It would also restrict the outflow of the proposed channel if concurrent flows occur.

PROJECT FORMULATION

Because of severe flood damages to homes in Mission Hill and to cropland in the area, the local people sought assistance from the Yankton County Conservation District to reduce their flooding problems. This resulted in a watershed

1/ "1969 Census of Agriculture" U.S. Department of Commerce.

information meeting held March 31, 1967, with written invitations to 150 landowners to attend. This meeting was held in Yankton, South Dakota, a few miles from the watershed. Representatives of the Soil Conservation Service explained the PL 566 watershed program. An application to the Secretary of Agriculture was submitted in September 1967, by the Yankton County Conservation District and the town of Mission Hill, for planning assistance on the Mission Hill Watershed under PL 566. This application was endorsed by Mission Hill Township.

On October 16 and 17, 1967, the watershed staff of the Soil Conservation Service conducted an investigation of the problems in the watershed and some possible solutions. This information was given to the South Dakota Soil and Water Conservation Committee for assistance in conducting the field examination.

On November 7 and 8, 1967, the South Dakota Soil and Water Conservation Committee conducted a public field examination. In addition to the South Dakota Soil and Water Conservation Committee, the following organizations were represented: Lower James Conservancy Sub-District; U. S. Fish and Wildlife Service; South Dakota Cooperative Extension Service; Mission Hill Town Board; South Dakota Department of Game, Fish and Parks; Yankton County Extension Agent; the Soil Conservation Service; the Mission Hill Watershed Steering Committee, and other interested residents of the watershed.

On January 15, 1968, the South Dakota Soil and Water Conservation Committee recommended to the South Dakota Water Resources Commission that the application be approved on behalf of the Governor of South Dakota. This was done on March 21, 1968.

On April 11, 1968, the application for planning assistance was forwarded to the Administrator of the Soil Conservation Service.

On May 15, 1969, the South Dakota Conservation Commission designated the Mission Hill Watershed as number one priority for preliminary investigation by the Soil Conservation Service in South Dakota.

On August 27, 1969, and again on December 3, 1969, the current status of planning was discussed at a joint agency meeting of SCS personnel and representatives of the U.S. Fish and Wildlife Service and the South Dakota Department of Game, Fish and Parks. Maps and other information used in planning were supplied to these agencies.

On December 30, 1969, the Yankton County Conservation District held public hearings and officially organized the Mission Hill Watershed District as prescribed by South Dakota law.

On March 12, 1970, the Mission Hill Watershed District held their annual meeting and invited the watershed staff of the Soil Conservation Service to attend. A progress report on the preliminary investigation was given to the Mission Hill Watershed District Board of Managers at the time indicating that a favorable project could be developed. They asked that the Soil Conservation Service complete the preparation of the preliminary investigation and give assistance in the preparation of the work plan.

The Soil Conservation Service assisted the sponsors in the completion and publication of the preliminary investigation report in March 1970, and requested planning authorization from the Administrator of the Soil Conservation Service. That authorization was received on July 27, 1970. Notification of

this authorization was mailed to about 70 local, state, and federal agencies.

In March 1971, correspondence with the South Dakota Department of Game, Fish, and Parks indicated that they did not have a forestry interest in the watershed but would contribute information for inclusion in the work plan.

On April 8, 1971, a public annual meeting of the Mission Hill Watershed District was held in the Mission Hill town hall with the Board of Managers, representatives of the South Dakota Water Resources Commission, Yankton County Conservation District, county Extension Service, and interested landowners attending. The watershed staff explained the current status of planning, discussed the proposals, and presented cost estimates on the proposed works of improvement. The Mission Hill Watershed District Board of Managers was in agreement that development of a final work plan should continue. No opposition to the plan was expressed.

On June 22, 1971, the current status of planning was discussed at a joint agency meeting of SCS personnel with representatives of the U.S. Fish and Wildlife Service and the South Dakota Department of Game, Fish and Parks. Information on planning progress and available details of the structural works were supplied on request.

In February 1972, a review draft report of the U.S. Fish and Wildlife Service was received by the Soil Conservation Service and comments were returned. This resulted in a draft report and further comments by the Soil Conservation Service dated May 8, 1972.

On March 1, 1972, the annual meeting of the Mission Hill Watershed District was held in Yankton, South Dakota. By newspaper notices and special mailings,

the public was invited to attend. The draft plan was discussed at that time. A number of interested landowners attended. Concern about the project was expressed by the landowner on whose land the proposed floodwater retarding structure is located. Questions concerning the sediment pool and flood pool were discussed and information given on depth and size. Additional information has been supplied periodically since that time. It was also explained that the use of several smaller upstream structures had been considered. Suitable locations that would control an adequate area could not be found. Less area controlled would require channel construction in Mission Hill and a larger channel in downstream areas.

The possibility of diverting the floodwaters out of the watershed at a point south of Mission Hill was also discussed and examined. This study was abandoned when it became obvious that extensive channel work was needed, local objections were strong, and an adequate outlet was not available.

Other landowners in the uplands were concerned that they might be required to apply land treatment against their wishes if the project were approved. It was explained that land treatment is a voluntary application of conservation practices installed by the landowner with technical assistance provided by the Soil Conservation Service. It was further explained that the goal of the Soil Conservation Service is 100 percent of the land properly treated but that 75 percent of the needed treatment must be installed above the floodwater retarding structure before installation and 50 percent of the remainder of the watershed must be properly treated.

On April 6, 1972, information on the current plan was submitted to the U. S. Fish and Wildlife Service. This included (1) aerial photos showing

location and stationing of proposed channel, (2) information showing where the channel location was changed to avoid habitat losses, (3) topographic maps of the floodwater structure with related storage information, (4) channel plan and profile sheets, and (5) SCS biologist wildlife evaluation report.

The 1973 annual meeting was held on March 7, in Yankton. In addition to newspaper notices, letters were sent to landowners in the watershed. Members of the watershed district board of managers also made some telephone calls to be sure residents knew of the meeting and were invited to attend.

During the planning process, other periodic contact and communications were maintained with the U.S. Forest Service; South Dakota Department of Game, Fish and Parks; U.S. Fish and Wildlife Service; South Dakota Department of Highways; Corps of Engineers; and the local people. Inquiries concerning the possibilities of historic or archeological sites in the watershed were made in May 1973. Agencies, organizations, and individuals contacted include: National Park Service, USDI, Lincoln, Nebraska; in South Dakota, the State Historic Preservation Officer, Vermillion; State Archeologist, Vermillion; and the South Dakota State Historical Society, Pierre.

Announcements of a meeting to be held in Yankton on October 16 and 17, 1973, were sent to the U.S. Fish and Wildlife Service; South Dakota Department of Game, Fish and Parks; and the Environmental Protection Agency. The plan was explained and questions were answered. A field trip to the watershed was made by interested individuals.

The 1974 annual meeting was held March 22 in Yankton. Notices of the meeting were sent to all landowners and published in the local newspaper. Information on the work plan was presented and questions were answered. On March 29, 1974, the watershed district notified the State Planning Agency of its intention

to request the Soil Conservation Service to enter into a work plan agreement for the installation of the project measure.

The informal field review was conducted by mail in April 1974. Copies of the preliminary draft work plan and environmental impact statement were sent to 18 local, state, and federal agencies. Suggestions for improving the plan and remarks on impacts not adequately treated were requested.

A public information meeting was held June 12, 1974, in Yankton. Notices of this meeting were sent to 34 local, state, and federal agencies, to legislators, and to local groups. In addition, notices were mailed to about 30 local people and announcements were published in the local paper.

Objectives

Although the goal of the Soil Conservation Service is 100 percent land treatment, the sponsors and the Soil Conservation Service agreed that wind and water erosion losses will be reduced to less than 5 tons per acre per year on at least 75 percent of the land above the floodwater retarding structure. They also agreed that similar reductions will be made on 50 percent of the remaining area. These reductions are to be accomplished during the 5-year installation period as described in this plan.

The sponsors and the Soil Conservation Service agreed that the objectives of the flood prevention measures are to eliminate floodwater damage to homes in Mission Hill (Reach III) for floods up to the 100-year frequency. The objective in Reach II is to reduce crop and pasture damage. Floodwaters from a 5-year frequency summer storm will temporarily flood about 390 acres but will be removed from this reach within 24 hours. Crop and pasture benefits in Reach I and Reach IV are incidental to the structural works needed for protection

in Reaches II and III.

Objectives also include a reduction in damage to roads and bridges. This reduction will occur mainly in Reaches III and IV as a result of reduced peak flows from the floodwater retarding structure. Damage will still occur from floodwater of storms exceeding 100-year frequency.

The accomplishment of these objectives will help achieve: (1) Quality in the natural resource base for sustained use, (2) Quality in the environment to provide attractive, convenient, and satisfying places to live, work, and play, (3) Quality in family standards of living based on community improvement, economic opportunity, and wholesome leisure opportunities.

Environmental Considerations

Consideration was given to impacts of the project on environmental quality. Construction areas will be revegetated as soon as possible to minimize the erosion hazard in the construction area. Channel work will be done from one side to reduce the loss of trees and to maintain a corridor of woody habitat. The planned channel route has been diverted in Reach I to avoid construction in a heavily wooded area. An outlet through the spoil area will provide water to this area. The planned channel was reduced in both length and size to minimize construction disturbance of vegetation and still provide adequate flood protection. Areas of woody vegetation will be established and shallow areas of overexcavation in the channel are planned to trap sediment during construction. They have value to wildlife until filled with sediment.

Scattered clumps or blocks of trees and shrubs planted at the site of the floodwater retarding structure will be beneficial to wildlife and will add beauty to the landscape.

Alternatives

Alternatives to the proposed plan that were considered are:

a. Accelerated land treatment only -

This alternative would have the same beneficial effect in upland areas as in the proposed plan, but floodwater damages would be reduced by only about 6 percent. This reduction would not be sufficient to permit efficient utilization of the flood plain areas, nor would adequate protection be given to the homes in Mission Hill.

Adverse effects of inundation by the sediment pool, the reduction in agricultural use during construction, and temporary loss of wildlife habitat would be avoided. Most of the downstream sediment damage would continue. The cost of this alternative would be $23,400.

b. Accelerated land treatment and the floodwater retarding structure -

This would adequately protect the homes in Mission Hill and would trap sediment. Channel work would be eliminated and the temporary loss of woody and herbaceous cover could be avoided. Without the channel, the floodwater structure would have only minor beneficial effects. The water would still be trapped on the flood plain after passing through the floodwater structure. The cost of this alternative would be $212,650.

c. Accelerated land treatment and the diversion of floodwaters -
The possibility of diverting the floodwaters around Mission Hill directly into the James River was also investigated. This would involve construction out of the watershed and there would be strong objections from landowners along the diversion. Deep cuts would be needed along with several grade stabilization structures and larger amounts of land for the diversion. Waterborne sediments would be carried into the James River. Adverse effects of the floodwater structure would be avoided.

Serious floodwater problems would still exist on the agricultural flood plain from uncontrolled water and there would still be a need for channel improvement to remove these floodwaters. The level of protection would be about the same. The cost of this alternative would be $835,830.

d. The proposed plan with longer and larger channel -
This alternative would increase the floodwater damage reduction benefits to the agricultural flood plain. There would be an additional 1.8 miles of channel at the upper end of the proposed channel. Floodwater benefits to Mission Hill would be about the same. There would be some additional disturbance of the environment and most of the sediment damage would continue. The cost of this alternative would be $608,750.

e. Land treatment and public acquisition of the flood plain in the agricultural area -
Purchase of the land would cost $546,000, not including relocation

and other severence costs, at the estimated value of $325 per acre. Several farm families would be displaced resulting in further decline of population in the rural area. In addition, there would be a loss of income from cash crops on the 1,680 acres of flood plain land and the loss due to damage of roads, bridges, homes, fences, and yards would continue. Purchase of lesser amounts of the most frequently flooded areas would be less costly but damages to other property would continue.

f. Accelerated land treatment with channel only -

Consideration was given to land treatment together with channel extending through Mission Hill and the agricultural flood plain with no floodwater retarding structure. This would provide adequate reduction in floodwater damages to both the town of Mission Hill and to the agricultural flood plain. However, most of the sediment moving downstream is presently deposited on the flood plain, pasture, road ditches, and in the channel. Without the floodwater retarding structure to trap the sediment, much of it would be carried downstream. The adverse effects of inundation by the sediment pool would be avoided. The estimated cost of this alternative is $642,100.

g. No project -

If the proposed project is not installed, it is estimated that approximately $32,280 in average annual net benefits would be foregone. In addition, flood problems and future damages will become more severe as sediment continues to fill the existing channel. Improvements in wildlife habitat, quality of the environment, and quality of life will

also be foregone. Adverse effects of the project would be avoided.

The floodwater retarding structure to protect Mission Hill, together with the channel improvement to carry the outflow from the structure and to remove excess water from the flood plain, minimizes adverse effects of the project and provides substantial beneficial effects to the environment. The land treatment measures will benefit the project by reducing both the volume of runoff and the amount of erosion in the watershed.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Land treatment measures are the basic elements of watershed projects. They are planned, installed, and maintained on privately owned land by individuals or groups of landowners and operators. The Soil Conservation Service will provide technical assistance in planning, consulting, and installing land treatment measures. A standard soil survey is in progress in Yankton County. Two Soil Conservation Service soil scientists are doing the detailed mapping. This survey will be beneficial during planning of land treatment measures in the watershed. Land treatment measures protect and improve the soil and water resources of individual farms and, at the same time, provide the highest feasible degree of runoff retardation, sediment control, and water management. Their effectiveness in reducing runoff, erosion, and sedimentation makes it imperative that they are included as an integral part of flood prevention projects. The installation of land treatment measures is considered essential to an effective watershed protection and flood prevention program. When installed, land treatment measures proposed in this work plan will exceed

minimum requirements. Emphasis will be given to the land treatment that will give a measurable reduction of erosion and sediment rates, keep surface runoff at a minumum, and maintain a high level of production. The installation of these practices is beneficial to the landowner, operator, and to the entire community.

Most of the flood plain soils have only minor limitation for sustained crop production; however protection from wind erosion is necessary. The areas with erosive soils have limitations for sustained crop production and require more intensive conservation management to reduce erosion. The accelerated land treatment program planned to be installed during the project includes practices which will adequately treat 1/ an additional 2,635 acres of cropland, 27 acres of pastureland, and 20 acres of forest land.

Land treatment alternatives usually exist. For example, contour farming with terraces are needed in some areas. An alternate solution may be contour stripcropping with a good conservation cropping system that includes minimum tillage and permanent grass cover,or a crop rotation that includes grasses or legumes. Another alternative may be a permanent cover of grass for pasture, hayland, or seed production. Other alternate solutions may exist but each problem must be handled independently.

Grassed waterways convey excess water through cultivated fields without damage by erosion. Alternates to this solution may include diverting the water to other areas where damage does not occur, or constructing grade stabilization structures to control gullies.

1/ Land adequately treated is land used within its capability on which the needed conservation practices that are essential to its protection and planned improvement have been applied.

Crop residue use is one of the easiest and most effective ways of reducing wind and water erosion problems. These residues, left on the surface, increase the infiltration rate of water into the soil and reduce the erosive effects of the wind.

Pasture and hayland management decreases the volume of runoff water and increases both the quality and quantity of grass or hay.

Woodland treatment measures improve hydrologic conditions onsite, help protect water quality offsite, and provide maximum economic return consistent with site capabilities. Woodland treatment measures include tree plantings, timber stand improvement, grazing control, proper timber harvesting, and fire control intensification. Technical assistance in fire control and forestry is available to landowners through ongoing programs by the State Forester for South Dakota under cooperative agreements with the U. S. Forest Service.

Other practices such as ponds, and pasture and hayland planting, can also be used to reduce conservation problems. Farmstead and feedlot windbreaks and wildlife habitat developments are examples of practices which complement other measures and make up the complete conservation program.

Structural Measures

Floodwater Retarding Structure: One floodwater retarding structure will be constructed. This will control the runoff from 5.85 square miles which is 94 percent of the watershed above Mission Hill and 44 percent of the total watershed area. The structure will be an earth embankment about 37 feet high. Refer to the typical drawing

on the following page.

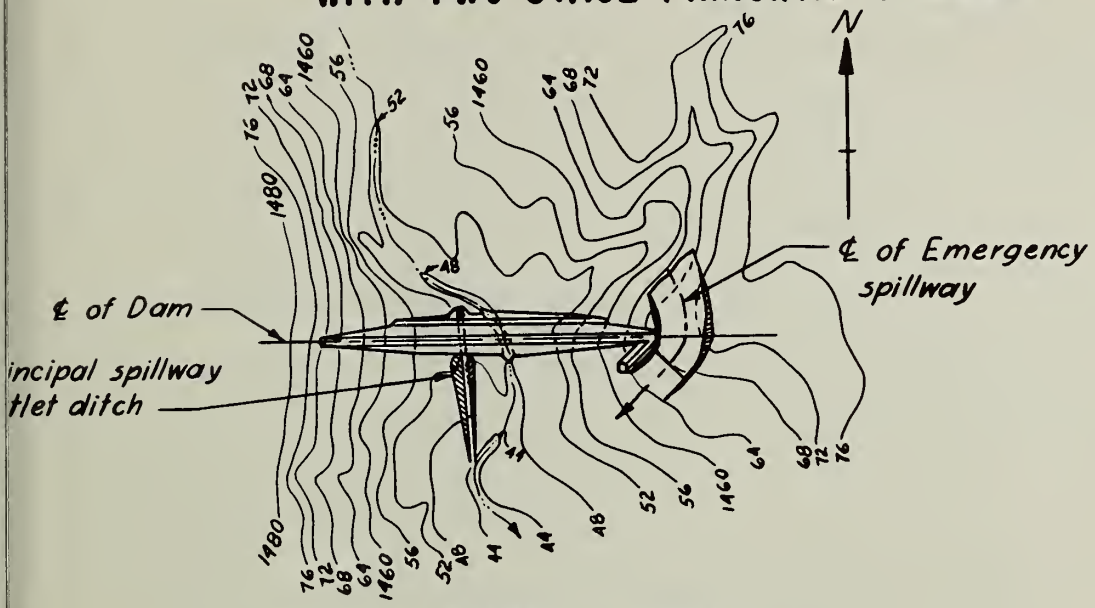
The material in the foundation of this structure is primarily glacial till overlying Niobrara Formation. This material is capable of withstanding the weight of the embankment and the principal spillway with only minimal consolidation. The fill materials will be glacial till, sand, clay and silt mixture with some gravels which will be excavated from the emergency spillway area. The principal spillway will be of reinforced concrete. The inlet will be an ungated two-stage standard covered riser. The outlet will be a 30-inch diameter conduit.

The first stage of the principal spillway is at the elevation of the top of the sediment pool which is expected to fill with sediment during the first 50-year period following construction. The first stage will have a maximum release rate of about 22 cubic feet per second. Structural modifications will be required to raise the first stage of the principal spillway when sediment fills the initial pool.

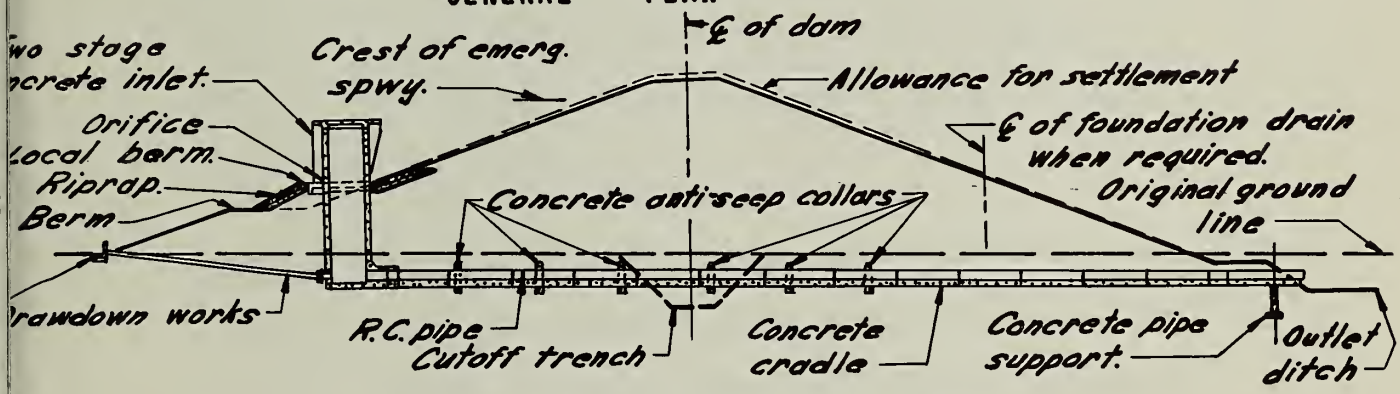
Storage of 1 inch of runoff from the drainage area above the structure will be provided between the first and second stages. This approximates the runoff produced by a 10-year frequency 6-hour duration storm.

The second stage of the principal spillway will have a maximum capacity of about 106 cubic feet per second. The total storage capacity of the structure to the emergency spillway crest will be 2.98 inches. This includes 2.71 inches for floodwater retarding storage and .27 inch for sediment storage. This combination of floodwater storage and principal

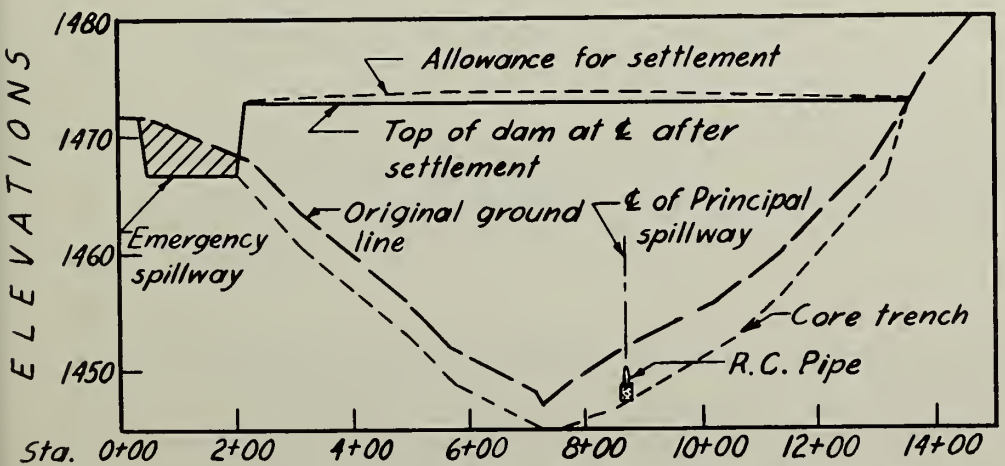
TYPICAL FLOODWATER RETARDING STRUCTURE WITH TWO STAGE PRINCIPAL SPILLWAY



GENERAL PLAN



CROSS SECTION OF DAM ON CENTERLINE OF TWO STAGE PRINCIPAL SPILLWAY



PROFILE ON CENTERLINE OF DAM

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spillway release will prevent emergency spillway flow for all storms of less than a 1 percent chance occurrence. The emergency spillway will be vegetative lined earth. It will have an inlet channel, a level crest section, and an outlet channel. The vertical distance between the top of the dam and the crest of the emergency spillway is about 5.7 feet. Landrights will need to be obtained for 30 acres in the dam and spillway area. This is presently in crop and pasture and no clearing is required.

The designed life of the structure will be 100 years. A drawdown tube will be installed near the bottom of the sediment pool. This will be left open and the pool will drain. Refer to table 3 for detailed structural data.

Geologic investigations indicate foundation conditions are such that leakage through the foundation would be high. It is doubtful that a desirable water level in a sediment pool could be maintained.

It is also the desire of the sponsors to maintain a dry pool so the reservoir can be utilized for pasture.

The embankment, emergency spillway, and borrow area will be revegetated with recommended varieties of grass and will be fenced to control grazing.

Scattered clumps or blocks of adapted trees and shrubs totaling not less than 2 acres will be planted in selected areas at the floodwater retarding site. These plantings will be a part of the revegetation measures. They will add beauty to the landscape and provide food and

cover for wildlife.

Two farmsteads will be protected from extremely high water in the floodpool of the floodwater retarding structure by the construction of dikes. These dikes will have gated pipes to allow local water to escape.

Channel: Approximately 3.8 miles of channel work is proposed as shown on the project map. The channel in Reach I is approximately 3.0 miles long and in Reach II, it is approximately 0.8 miles in length. The capacity of this channel is based on the low stage release rate from the floodwater retarding structure and the 20 percent chance, 24-hour removal from the uncontrolled drainage area below the structure.

Construction of the channel will require 94 acres of working area during construction. The channel will be constructed in a previously modified ephemeral channel in Reach II and in part of Reach I for a distance of 2.8 miles. The diversion in Reach I from station 385+70 to 439+60 will be new construction for about 1 mile. There are permeable fine sands with silts in Reach I. Reach II material consists of silts, clays, and sands. No channel work is planned for Reaches III and IV.

To insure stability in the more erodible materials, the channel will be constructed with 3:1 side slopes and the design velocities will be less than 2 feet per second. Additional maintenance will be needed to remove sediment. The bottom width of the channel varies from 16 feet in Reach I to 18 feet in Reach II. The flow depth for the design capacity varies from 2.6 feet to 3.6 feet in Reach I. The total depth of cut is up to 10 feet in the diversion. The flow depth is 3.4 feet in Reach II for the design capacity. Total depth is less than 5 feet.

A minimum berm width of 15 feet will be maintained. The inside of the spoil area will have a 3 to 1 slope and the height will be about 2 feet. Top width on the spoil area will be not less than 10 feet. The outside slope will be variable but generally 6 to 1 slope, or flatter. Field inlets will be provided to allow surface water to enter the channels. Refer to table 3A for detailed design information. A typical cross section is shown on the following page.

The constructed channel alignment will follow the existing channel as much as possible. Some deviations from the existing channel will be made to satisfy requests from landowners or to minimize woody habitat losses. The channel will be relocated as follows in Reach I:

SE¼ sec. 5, T. 93 N., R. 54 W., approximate station 292+90 to station 301+90, right bank construction only to reduce woody habitat loss.

NE¼ sec. 8, T. 93 N., R. 54 W., approximate station 301+90 to station 305+90, right bank construction only.

W½ sec. 8, T. 93 N., R. 54 W., approximate station 332+50 to station 367+60, follow field boundary.

NW¼ sec. 17, T. 93 N., R. 54 W., approximate station 367+60 to station 385+70, change field boundary.

sec. 17, T. 93 N., R. 54 W., approximate station 385+70 to station 439+60. Following the existing channel in this section would require construction in a heavily wooded, brushy area with good wildlife habitat value. To avoid this, a new route was chosen southwest of the existing oxbow as shown on the project map. A pipe outlet will be placed in the channelbank near station 385+70 to allow low flows of water to continue in this abandoned oxbow.

Following construction, the disturbed areas within the construction landrights areas will be revegetated to adapted grasses. After grass is established, trees and shrubs will be scalp-planted as part of the revegetation measures. These will be single row plantings in

Reaches I and II, along the channel landrights. Appropriate gaps will be left in the plantings to add attractiveness. The approximate footage for these plantings is as follows:

sec. 4, T. 93 N., R. 54 W., - 2,000 feet in Reach II
sec. 8, T. 93 N., R. 54 W., - 1,500 feet in Reach I
sec. 17, T. 93 N., R. 54 W., - 550 feet in Reach I

There are 1.1 acres in these single row plantings.

An additional block planting of 1.1 acres of trees will be planted in the SW¼ of section 8. This will be installed as a mitigation measure. The planting will consist of a mixture of trees and shrubs that will provide food and cover for wildlife.

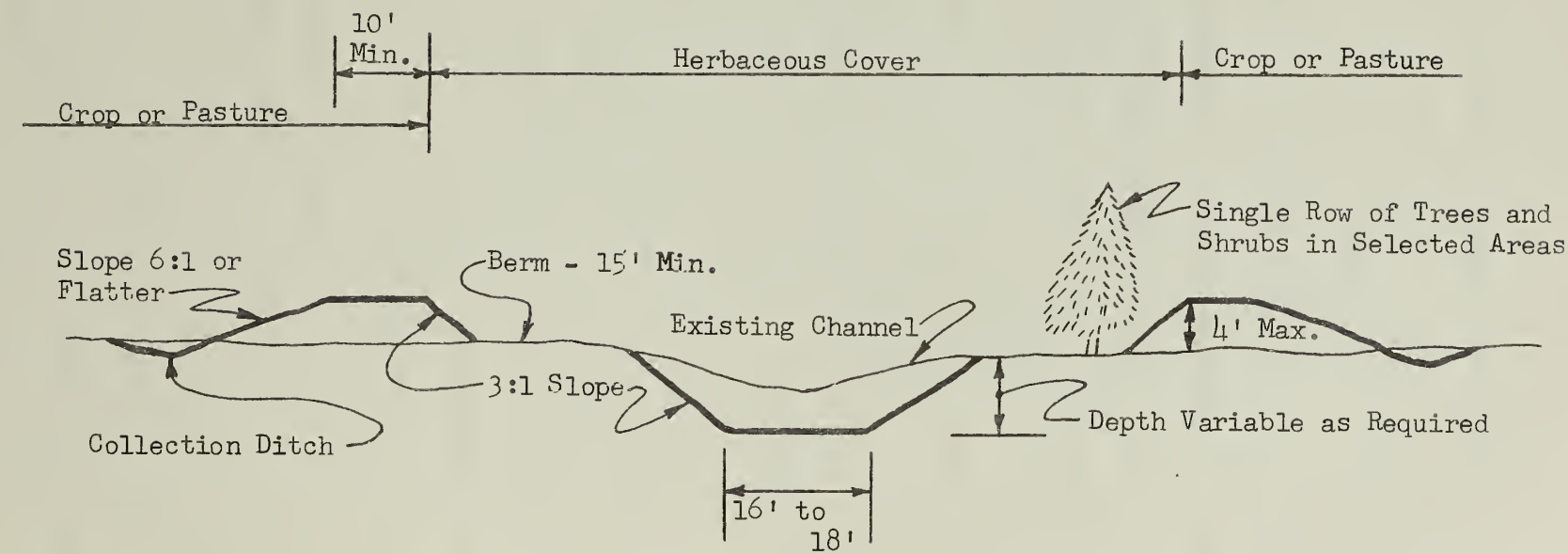
The channel will be widened and overexcavated about 4 feet below channel bottom and 100 feet in length near these plantings to provide ponded areas. The exact location and width will be determined after geologic [illegible] investigations have been made prior to final design. These investigations will be used to help select sites that have the best water-holding capacity. These areas will trap sediment during construction and will be useful for wildlife until they are filled with sediment.

To minimize erosion during construction, the contractor will not be allowed to construct over 2 miles of channel in advance of grass seeding and mulching operations. Also, grass seeding shall be completed within 7 days after completion of construction at each location.

Burning operations shall be in conformance with the Air Pollution Control Regulations (Section 4.2.6) for the State of South Dakota as adopted by the South Dakota Air Pollution Control Commission. All applicable federal, state, and local laws shall be complied with. Burial of refuse

TYPICAL MISSION HILL WATERSHED

CHANNEL CROSS SECTION



material is preferable to burning.

To aid in giving proper attention to health protection, the Public Health Monograph entitled, "Prevention and Control of Vector Problems Associated with Water Resources," dated January 1965, will be used.

Although no archeological or historic sites are known to exist, every effort will be made to preserve any sites that may be exposed during construction. All reasonable precautions will be taken to determine whether items of historical and archeological value exist. Archeological and historical surveys will be conducted prior to construction by individuals considered qualified by the South Dakota State Archeologist and the South Dakota State Historical Preservation Officer. If a site of archeological value is discovered during construction, work will cease and the Chief Archeologist of the Midwest Archeological Center, National Park Service, Lincoln, Nebraska, and the State Archeologist, Vermillion, South Dakota,will be notified. If historical sites are located, the State Historical Preservation Officer will be notified. Public Laws 86-523 and 89-665 will be adhered to. Public Law 86-523 and 89-665 pertain to historic and archeological materials, data, and properties which are important to American history and culture.

Grade Stabilization: One grade stabilization structure will be constructed in the channel at station 433+00 in Reach I. This structure will allow the water from the channel to enter the Missouri River on a stable grade. This will be a straight drop spillway with a capacity of about 375 cubic feet per second. This capacity is based on a storm that has a 1 percent chance of occurring. The total drop in this structure will be about 9.6 feet. Refer to the typical drawing on the following page and to table 3b for detailed structural data.

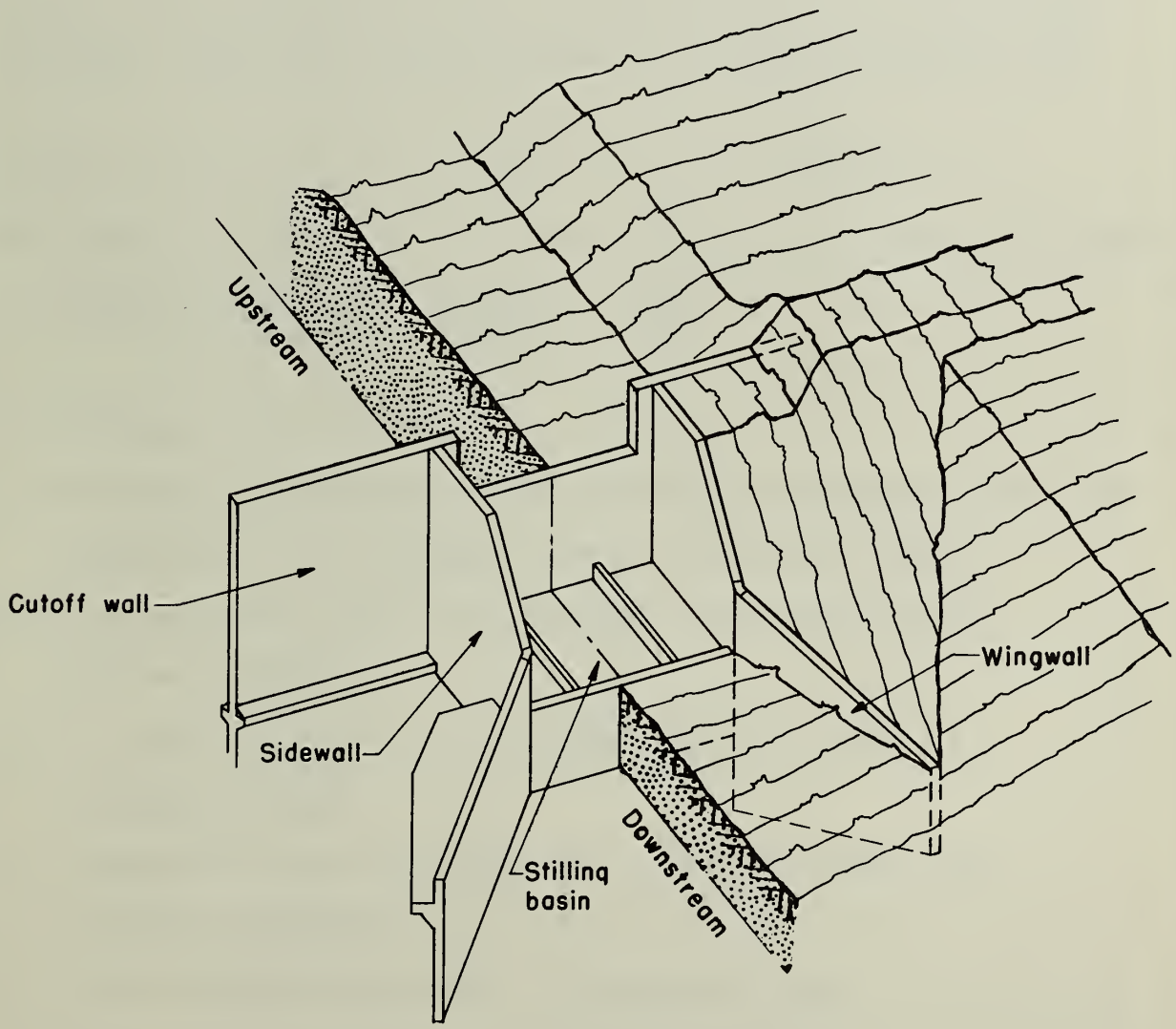
EXPLANATION OF INSTALLATION COST

The federal government will provide technical assistance for implementing land treatment measures within the watershed. This includes assistance in planning, layout, and checking these measures through PL 566 funds and other federal funds. The actual installation of land treatment measures is the responsibility of the individual landowners. Cost sharing may be available for the establishment of conservation practices through cost sharing programs on the federal, state, or local level.

The PL 566 installation costs for structural measures shown in the work plan include construction costs, engineering costs, and project administration costs. Major construction costs include costs for earth moving, principal spillway, fencing, mulching and seeding, field inlets, and reinforced concrete. Construction quantities were determined from field survey data and unit costs were based on current construction costs. A 12 percent contingency allowance was included for rising costs and unforeseen problems during construction. Engineering costs include costs for: services of engineers and geologists for surveys; geologic site investigations; soil mechanics tests; structural designs; and preparing plans and specifications. These costs are computed as a percentage of the construction costs. Project administration costs include costs for construction inspection, administration of contracts, and administrativ assistance and program supervision at all levels concerned with the conduct of the program. Project administration costs are computed as a percentage of the construction costs.

The Mission Hill Watershed District Board of Managers requested that the Soil Conservation Service administer contracts. This includes preparing

TYPICAL GRADE STABILIZATION STRUCTURE
CONCRETE DROP SPILLWAY



PERSPECTIVE VIEW

invitations to bid, awarding contracts, and making payment for contract work.

The watershed district is responsible for the costs of landrights. These costs include costs for land, altering roads, replacing bridges, relocating utility lines, constructing field crossings, moving or protecting farm buildings, removing and replacing fences, and legal and appraisal fees.

Refer to tables 1 and 2 for information on installation costs.

The total estimated cost of the project is $541,110 and will be distributed as follows:

PL 566 funds	$425,660	79%
Other funds	115,450	21%

The following are PL 566 costs:

1. The cost of technical assistance needed to accelerate the planning and application of land treatment measures. (Estimated $8,400)
2. The construction cost of the floodwater retarding structure. (Estimated $129,300)
3. The construction cost of the grade stabilization structure. (Estimated $57,000)
4. Construction cost of approximately 3.8 miles of channel work. (Estimated $144,000)
5. Project Administration costs. (Estimated $58,940)
6. Engineering service costs. (Estimated $28,020)

Other funds will pay the following costs:

1. The cost of installing land treatment measures. (Estimated $15,000) This includes:
   a. Cost of technical assistance for existing land treatment programs. (Estimated $1,100)

b. The cost of technical assistance for installing and maintaining going program on forest land. (Estimated $1,000)

2. The cost of landrights needed for structural measures. (Estimated $99,750) This includes a cost of $31,350 for land; $1,900 for legal and appraisal fees; $39,600 for road and bridge; $9,500 for farmstead protection; $9,000 for relocating utility lines; $5,600 for field crossings; and $2,800 for fencing.

3. Project administration. ($700) This includes local administration costs incurred by the sponsors.

The estimated total PL 566 and other obligations scheduled by fiscal year are as follows:

	PL 566 Funds		Other Funds	
Year	Land Treatment	Structures	Land Treatment	Structures
First	$1,800	-	$3,000	$25,000
Second	1,800	$ 9,000	3,000	37,000
Third	1,700	150,000	3,000	20,000
Fourth	1,700	165,000	3,000	18,450
Fifth	1,400	93,260	3,000	-

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention, Erosion, and Sediment

When the land treatment and structural measures are installed, both agricultural and nonagricultural damages by flooding will be reduced 87 percent. The high degree of damage reduction is due to the favorable location of the floodwater retarding structure relative to the benefit area in combination with channel work. The primary effects of land treatment are conserving the soil as a productive resource (19.6 percent soil loss reduction), protection of structural

measures against sedimentation (17.5 percent reduction) and improved water quality, (416 p/m reduction).

The conservation cropping systems and crop residue use that will be applied to cropland will reduce wind and water erosion and increase the ability of the soil to absorb water. This helps to reduce downstream flooding, increases the available soil moisture, and improves and maintains the physical condition of the soil.

Contour farming and terraces delay the downstream movement of the water thereby allowing more water to infiltrate the soil. Terraces carry the excess water at a nonerosive velocity to a grassed waterway which safely disposes of excess water without erosion damage. Also eliminated is the inconvenience and cost of detouring around gullies.

Pasture and hayland management and pasture and hayland planting will reduce runoff and increase pasture production. Increased pasture production provides economic returns that encourage the use of land as pasture or hayland in contrast to cropland.

The forest land treatment program will make woodlands more effective in holding water and reducing erosion and downstream sedimentation. Forestry measures maintain and improve the watershed protection benefits of existing tree cover. Farmstead and field windbreaks prevent soil from blowing and protect buildings.

Ponds for livestock water help to properly distribute grazing and enhance the opportunities for higher livestock gains.

The accelerated land treatment measures reduce the volume of sediment deposition in 4 acres of wetlands. Turnrows used with contour farming and terraces are generally seeded to alfalfa or grass. Grassed waterways also create additional vegetated areas by converting raw gullies and waterways to areas of herbaceous cover.

The sediment pool of the floodwater retarding structure has an area of 7 surface acres and is not expected to hold water for long periods of time; however it will provide a small, temporary wet area in which a fringe of aquatic vegetation will develop. The earth embankment and emergency spillway will be revegetated with grass. Trees and shrubs will also be part of the revegetation. This will provide 23 acres of herbaceous and 2 acres of woody cover. Grazing will be carefully controlled on this area. There are 2.9 miles of channel work in areas that are presently in cropland. These areas will be seeded to grass and will provide additional permanent vegetation. Revegetation of disturbed soils will include woody plantings in selected areas along the channel for esthetic values and wildlife habitat.

The floodwater retarding structure will provide 100-year frequency protection from floodwaters immediately downstream in Reach IV. (See project map.) The county road which has washed out or been damaged many times in the past will be protected from overtopping. Crop and pasture damage will be eliminated for all but the most severe storms and debris will be trapped. The floodwater retarding structure will control 5.85 square miles, or 94 percent, of the drainage area above Mission Hill. The 845.4 acre-feet of flood storage and the principal spillway release of 106 cubic feet per second will control the runoff from a 100-year frequency flood without emergency spillway flow.

Flood protection to the existing homes in Mission Hill will exceed 100-year frequency. While the proposed reservoir offers a high degree of protection to existing property, it would still be possible to have flooding and damages in the future if very unusual rainfall amounts occurred. Future flooding may come from the uncontrolled area above town and flow through the emergency spillway. Although the uncontrolled area below the floodwater retarding structure is relatively small and the potential peaks will be reduced, further development of the flood plain for homes or other high value property should be discouraged.

At least nine houses, fences, roads, bridges, garages, and other property in Mission Hill will be protected from flood damage from most floods. The personal safety and well-being of the residents will be improved.

Protection from overtopping of roads and bridges in Mission Hill will also exceed a 100-year frequency storm if debris does not obstruct the bridges.

If the project had been installed prior to the 1966 storm, peak flows in Mission Hill would have been reduced so that no damage would have occurred to nine homes.

The works of improvement will not eliminate flooding in the agricultural area of Reach II but will reduce the damages.

Floods of a 5-year frequency summer storm, or smaller, may temporarily inundate cropland but the duration of flooding will be reduced from several weeks to less than 24 hours. Floods greater than a 5-year frequency storm will cause flooding for more than 24 hours but damages from these storms will also be reduced by the removal of the floodwater. Floods from

snowmelt will also occur but removal of floodwaters will begin as soon as the channel is clear of ice and snow. This will reduce the delay in spring planting from several weeks, or more, to a few days.

With the project installed, acres flooded more than 24 hours in Reach II from a 100-year storm will be reduced from 1,100 acres to 665 acres and the average annual flooding from 475 acres to 55 acres.

If the project had been installed at the time of the 1966 flood, the flooding of 855 acres for more than 24 hours would have been reduced to 55 acres. This reduction in duration of flooding would have reduced damages to the existing crops and lessened the need for replanting.

The installation of the floodwater retarding structure and the removal of the sediment from the channel will prevent the overflow of floodwater out of the watershed for most storms.

The restoration of the channel in Reach I to its approximate historic grade will remove floodwaters which are currently trapped by the sediment filled channel. It will also reduce flooding from upstream flows and from large rainstorms and snowmelt floods in the adjacent area. Flows will be diverted to the southwest and through the grade stabilization structure where the water will enter the Missouri River at nonerosive velocity.

The project will reduce the area flooded from a 100-year frequency flood from 1,680 acres to 1,055 acres.

Twenty-one landowners in the flood plain will benefit directly from the flood control measures. The remaining landowners will benefit from the acceleration

of the planning and application of the soil and water conservation measures. In addition, all taxpayers will benefit from the reduction in road and bridge damage. A more stabilized and better income to farm families will aid in the overall economic development of the area. Local underemployed laborers' income will be increased because of the installation and maintenance of the structural measures. Business will increase as a result of additional services required by farmers living in the watershed. Processing of agricultural products and sales of products used by farmers will be stimulated.

Peak flows in the watershed will change substantially. The estimated 100-year peak flow at the floodwater retarding structure will be reduced from 2,850 cubic feet per second to 106 cubic feet per second. At the lower end of Reach II, where removal of the sediment from the channel is proposed, the existing flows for a 5-year frequency storm are a few cubic feet per second. With the channel restored it will have the capacity to remove the 5-year frequency, 24-hour runoff from the uncontrolled area plus the release from the low stage of the floodwater structure. This combined flow is 94 cubic feet per second.

Land use in the flood plain with the project is expected to change very little. About 70 percent of the flood plain is used for corn production. Most of this corn is used for livestock feed. Second in importance is alfalfa-brome grass mixture grown on 26 percent of the flood plain. Soybeans and other uses make up the remaining 4 percent. Future use with the project may depend on market conditions.

Benefits from increased production of surplus crops on new lands are not necessary for economic justification. About 321 acres will receive more

intensive use benefits. These benefits will accrue by insuring more efficient use of the flood plain with the flood hazard reduced. Operators will make better use of fertilizers and other management practices which contribute to a stabilized net income for farmers and provide for a better life in rural America.

The 7 acres of pasture in the sediment pool will have a gradual loss of value for grazing as the sediment pool fills over the 100-year period. The construction of the floodwater retarding structure and emergency spillway will result in a change of use of 23 acres of cropland with a resulting annual loss of 1,100 bushels of corn and 17 tons of alfalfa. Change of use of 25 acres of cropland due to channel work will result in an annual loss of 1,500 bushels of corn and 30 tons of alfalfa.

Erosion rates in the watershed will be reduced by land treatment. Sheet and rill erosion will be reduced 1,500 tons annually, or about 20 percent.

About 98 percent of the sediment produced and delivered to the floodwater retarding structure will be trapped behind the structure.

Sediment deposition in the channel will be reduced from an estimated 0.15 foot per year to 0.04 foot per year. Sediment damage to roads, bridges, and channel will be reduced 83 percent. Annual sediment damage to hayland, pasture, yards, and gardens will be reduced 63 percent.

The reduction in sediment,through improved land management and flood control, will reduce the sediment concentration and associated agricultural chemical contaminants. Fertilizers, particularly phosphorus, become fixed to clay particles and are moved from the croplands when the soil is eroded. Herbicides and insecticides also attach to some soils and move when the "host" particle

is eroded. The sediment is moved into the stream system with the associated contaminants increasing turbidity and generally decreasing the water quality.

Average annual sediment yield from the watershed will be reduced to about 89 tons after the project has been installed. The average annual sediment rate without the project is estimated at 125 tons. This is a reduction of 36 tons annually. Conservation practices installed in the watershed, plus the sediment trapped behind the floodwater retarding structure, will reduce gross sediment rates. Based on estimated gross erosion rates, sediment delivery ratios, and estimated average annual yield, it is determined that the sediment concentration of water leaving the watershed will be reduced to about 94 p/m. This compares with the sediment concentration of 89 p/m measured in the Missouri River during the period of 1955 to 1969, according to information received from the Corps of Engineers.

Fish and Wildlife

The grass turnstrips generally used with the contour farming and the grassed waterways provide nesting cover, food, and shelter for upland game. The farmstead windbreaks and field windbreak plantings provide cover for upland wildlife. The ponds for livestock water are used by all forms of wildlife. Pasture and hayland planting and pasture and hayland management also provide additional vegetation usable by wildlife.

Areas of aquatic vegetation that develop at the floodwater retarding structure and the grade stabilization structure are also used by wildlife. Not less than 2 acres of scattered clumps or blocks of trees and shrubs to be planted at the site of the structure will provide food and cover for wildlife. These trees and shrubs will also add beauty to the landscape.

The project will modify the channel characteristics of 2.8 miles of channel by deepening, widening, and relocating. This will remove the obstructions that have formed due to wind and waterborne sediments and farming operations and will allow floodwaters to move downstream.

In Reach II an area of woody habitat of less than 0.1 acre will be removed due to channel construction just east of the road at station 279+40.

In Reach I, from station 292+90 to 301+90, about 0.5 acre of woody habitat will be removed from the right side of the channel. From station 301+90 to 305+90, less than 0.1 acre of woody habitat will be removed from the right bank. In the NW¼ of section 8, a stringer of trees cut down in 1967 have regrown. About 0.4 acre will be removed. From station 358+30 to station 362+10, 1.1 acres of trees will be removed from a farmstead windbreak. At station 385+70, a new channel will be constructed to carry the flow west and south of the existing channel. A pipe through the spoil area will supply the existing channel with water in addition to that from the surrounding area. The relocated channel will cross cropland until it drops to the Missouri River flood plain through a grade stabilization structure. A new channel will then carry it to the Missouri River. About 1.2 acres of woody habitat will be removed at that point. The total loss of trees and shrubs is 3.4 acres.

Following construction, the disturbed areas will be revegetated to adapted grasses. After grass is established, trees and shrubs will be scalp-planted as part of the revegetation measures. These will be single row plantings in intermittent reaches along the channel. Openings will be left in the plantings to add to the beauty of the landscape. The approximate footage for these plantings is as follows:

sec. 4, T. 93 N., R. 54 W., - 2,000 feet
sec. 8, T. 93 N., R. 54 W., - 1,500 feet
sec. 17, T. 93 N., R. 54 W., - 550 feet

These plantings will consist of nonsuckering shrubs and medium sized trees, including conifers. They will be placed in areas adjacent to cropland to avoid grazing by livestock. These plantings will add beauty to the landscape as well as provide habitat and food for wildlife. These single row plantings will replace 1.1 acres of the existing trees and shrubs. An additional 1.1 acres of trees and shrubs will be planted in a block planting in the SW¼ of section 8 for the purpose of mitigating other losses.

The 1.2 acres of trees on the Missouri River bottom near the drop structure will not be replaced. The channel area will be seeded to a mixture of grass dominated by warm season native grasses. In an area of dense river bottom woodland, this narrow strip of herbaceous vegetation will serve to diversify the habitat and benefit wildlife.

A total of 94 acres of cropland, pasture, herbaceous habitat, and woody habitat will be disturbed during construction of the channel. Use by wildlife and agriculture will be interrupted. Sixteen acres of the disturbed area is adjacent to cropland and presently provides herbaceous habitat. These areas receive little or no grazing use. With the project, 42 acres of channel berm and spoil area adjacent to cropland will be seeded to grass and will provide herbaceous habitat for wildlife. This is a habitat gain of 26 acres. Little or no grazing use is expected on this area. There will be a loss of 25 acres of cropland. Areas presently pastured along the channel are expected to remain in pasture as they are associated with the farmstead livestock operation. About 30 acres of cropland and pasture will be disturbed

by construction of the floodwater retarding structure. Agricultural and wildlife uses will be interrupted. Maintenance measures necessary to remove accumulated sediment will cause a periodic disturbance of vegetation in the channel.

Seven acres of pasture and about 0.6 mile of ephemeral stream will be temporarily inundated when the sediment pool is full of water. Its use for grazing will be reduced. When the floodpool is full of water it will draw down in approximately 13 days. A 10-year frequency storm will inundate less than 50 acres for about 10 days. About 10 acres of cropland in the 10-year pool will be converted to pasture. Agriculture or wildlife use will be interrupted during inundation. The floodwater structure and associated emergency spillway will occupy about 2 acres that is presently pasture and 23 acres that is now cropland. Agricultural and wildlife use will be interrupted during construction. Upon completion of construction these acres will be revegetated. This area will be fenced and protected from grazing during the period of grass establishment. Because of the critical nature of this site, grazing, if it is permitted, will be limited. The revegetation that protects these soils will provide habitat for upland game.

Changes from private to public ownership of land are not anticipated.

There are no wetlands that will be affected by the project except two areas previously described that will benefit from reduced sediment due to land treatment.

Economic and Social

The economy of the watershed is dominated by agriculture. Opportunities for employment within the boundaries of the watershed are limited. However, an

unemployment rate of less than 3 percent for Yankton County suggests that alternative opportunities for employment are available nearby.

The opportunity for increasing agricultural efficiency and income stability from supplemental sources is limited. A more stabilized income is expected for farm families living in the flood plain. Business will improve as a result of additional services required by farmers. Processing of more agricultural products and increased sales of production inputs, such as fertilizer, will stimulate the local economy.

Secondary effects of the project will result in increased income earned by the locally underemployed laborers resulting from installation and maintenance of the structural measures. This will provide a stimulus to the local economy and help make rural America a better place in which to live. The installation of the project will result in no change of available open space.

Other

The net changes in land use expected as a result of the project are a loss of 58 acres of cropland. There will be a gain of 1 acre of woody habitat, 8 acres of pasture, and 49 acres of herbaceous habitat that will receive light or no grazing.

PROJECT BENEFITS

Total estimated average annual floodwater damages in the watershed are $51,400 under "without project conditions." After land treatment measures are applied, these damages will be reduced to $49,100. With the structural measures installed, the average annual damages will be reduced to $6,300.

The average annual damage reduction benefits due to channel improvement and the floodwater retarding structure are $42,800. The total damage reduction benefits are $45,100. Under "without project conditions," the average annual damages to crops and pastures are $37,700. With the project installed, these damages will be reduced to $4,300, or 89 percent.

Other agricultural damages "without project" are $4,100 which will be reduced to $500 for an annual benefit of $3,600. The "without project" average annual damages of $900 to the town of Mission Hill will be eliminated with the installation of the floodwater retarding structure. Floods greater than the 1 percent chance event have not been considered in this analysis. Road and bridge damages will be reduced from $1,500 annually to $300. Sediment damages to roads, bridges, and channel, without the project, are $1,570 which will be reduced to $280 for an annual benefit of $1,290. Other sediment damage to hayland, pasture, yards and gardens, without the project, is $960. This will be reduced to $350 "with project" for an annual benefit of $610.

COMPARISON OF BENEFITS AND COSTS

The ratio of the average annual benefits to average annual costs is 1.9:1.0. When secondary benefits are not considered, the benefit-cost ratio is 1.2:1.0.

PROJECT INSTALLATION

The measures outlined in the plan are to be installed in a 5-year project period.

The land treatment measures will be installed prior to, or concurrently with, the installation of the floodwater retarding structure and the channel work. Individual farmers will install the land treatment measures. See table 1.

Leadership for applying these measures will be provided by the Yankton County Conservation District. The district will be supported by the Mission Hill Watershed District.

The Soil Conservation Service will provide technical assistance to accelerate the planning and application of needed land treatment measures and soil surveys.

Assistance with the information and educational programs will be the continuing responsibility of the Extension Service. Cost sharing assistance may be provided by federal, state, or local programs.

Technical assistance for forestry measures will be furnished by the Soil Conservation Service and the South Dakota Department of Game, Fish, and Parks, Division of Forestry and Parks, through cooperative agreements with the Forest Service, United States Department of Agriculture.

Fire control measures will be installed by rural fire districts through the Cooperative Fire Control Program. This technical assistance will be provided by the South Dakota State Forester through cooperative agreement with the U.S. Forest Service.

The Farmers Home Administration makes operating, conservation, and other loans which facilitate land treatment.

The South Dakota Department of Game, Fish, and Parks provides technical assistance and cost shares through the Wildlife Habitat Improvement Program.

During the first year emphasis will be given to the acceleration of the planning and application of the effective land treatment measures.

Acquistion of landrights for the floodwater retarding structure and the channel work will be initiated.

The planning and application of land treatment measures will continue during the second project year. Acquisition of landrights for construction purposes on the floodwater retarding structure should be completed and acquisition for the channel will continue. Design of the floodwater retarding structure will be completed. Acquisition of landrights for the grade stabilization structure will also be completed.

During the third year, planning and application of land treatment measures above the floodwater retarding structure will be completed and the floodwater retarding structure will be constructed. All remaining landrights will be acquired and the design of the grade stabilization structure will be completed.

During the fourth project year the grade stabilization structure will be constructed and channel work will begin. Land treatment will continue.

Construction and land treatment will be completed during the fifth project year.

The Soil Conservation Service, at the request of the Mission Hill Watershed District, will do the contracting for the construction of all structural measures. The Mission Hill Watershed District will work with the Soil Conservation Service during construction.

Prior to the Soil Conservation Service awarding of the contracts, the Board of Managers of the Mission Hill Watershed District will secure necessary landrights. The Managers receive their authority under the South Dakota Watershed Act, as amended in 1959. Under this act these managers have the legal power to tax, buy, and receive property; execute contracts; and incur

debts, liabilities, or obligations. The district has the power of eminent domain and will exercise its authority to acquire landrights, if needed.

Before Invitations to Bids are issued for construction, the Mission Hill Watershed District will have recorded the necessary landrights.

The sponsors will adhere to Public Law 91-646 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 in the securing of landrights.

The first step will be to determine the landrights needed and discuss the requirements with the landowner. If the landowner is willing to donate the land he may do so and an appraisal will not be necessary. If the landowner is unwilling to donate the land, a qualified land appraiser will be secured, the land will be appraised, and the price will be negotiated.

The Yankton County Conservation District will assure that 75 percent of the effective land treatment above the floodwater retarding structure and 50 percent on the remainder of the watershed will be applied before, or concurrent with, construction. They will also provide assurance that 50 percent of the land upstream from the floodwater retarding structure has proper conservation plans. In addition, an operation and maintenance agreement and a project agreement will be executed before construction of the structural measures is initiated.

The Soil Conservation Service will provide technical assistance to the sponsors to: (1) Design structures, (2) Prepare specifications, (3) Inspect construction, (4) Prepare contract payment estimates, (5) Make final inspections and execute certificate of completion. The Soil Conservation

Service will also perform other related duties connected with the installation of the planned structural measures.

FINANCING PROJECT INSTALLATION

The Mission Hill Watershed District is the financial sponsor for the project. The district will develop a financial plan using the authority as prescribed in the South Dakota Watershed Act as amended.

The Mission Hill Watershed District Board of Managers plans to obtain a Farmers Home Administration loan to cover the local installation costs. The annual repayment of interest and principal will be included as part of the financial plan. A preliminary application for securing a loan has been filed with the State Director of the Farmers Home Administration. Funds needed for operation and maintenance costs and the repayment of the loan will be raised by taxation.

Public Law 566 funds and assistance contingent on the appropriation of funds for this purpose will be made available when local responsibilities have been fulfilled. The local responsibilities include the providing of landrights, meeting the 50 percent proper conservation plan requirement, and the 75 percent land treatment requirement. In addition, operation and maintenance agreements and project agreements must be executed. In the installation of land treatment measures described in this plan, federal assistance in cost sharing may be utilized if available under federal, state, or county programs.

All costs of forestry land treatment and fire control measures will be borne by individual landowners, rural fire districts, and other federal or local programs, if available. Technical assistance to landowners and operators will

be provided by the Soil Conservation Service and by the State of South Dakota cooperating with the U.S. Forest Service.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

The operation and maintenance of land treatment measures will be performed by the landowners and operators on whose land they are applied in accordance with the Conservation District Agreements. Periodic inspections will be made by personnel of the Yankton County Conservation District, the Mission Hill Watershed District, the Soil Conservation Service, and the Forest Service, in order to determine maintenance needed to keep the land treatment measures effective.

Structural Measures

The Mission Hill Watershed District will assume the responsibility for operation and maintenance of structural measures. This responsibility will be outlined in the Operation and Maintenance Agreement that will be executed prior to awarding construction contracts. These agreements will be between the Soil Conservation Service and the Mission Hill Watershed District. Average annual operation and maintenance costs are estimated to be $1,580.

As the structural measures are constructed, operation and maintenance funds will be collected. When the project is completed, a reserve fund will be available equal to, or greater than, the annual operation and maintenance cost estimated to be $1,580. An operation and maintenance budget will be developed each year to take care of current needs and to maintain the reserve fund. The Mission Hill Watershed District and the Soil Conservation Service will make a joint Operations and Maintenance Inspection annually, after

unusually severe floods, and after the occurrence of other unusual conditions that might adversely affect the structural measures. These inspections will continue for at least 3 years following installation of each structure. Inspections after the third year will be made annually by the Mission Hill Watershed District. They will prepare a report and provide a copy to the Soil Conservation Service employee responsible for Operation and Maintenance Inspections and follow up. In situations where conditions indicate need for continued assistance from the Soil Conservation Service, this assistance may be provided after the third year.

The items of inspection will include, but are not limited to, the condition of the structure and appurtenances, the vegetative cover, the need for control of vegetation to prevent the reduction of channel capacities, and the need for the removal of accumulated sediments in the channel. Other items which may require frequent maintenance is the clearing of trashracks after severe storms and maintaining unrestricted outlets below principal spillways.

The trees installed as mitigation measures will require cultivation during the establishment period and grazing will be prohibited.

Installation Cost Item	Unit	Number		Estimated Cost (Dollars) 1/						
				P.L. 566 Funds			Other			
		Non-Fed. Land	Total	Non-Fed. Land SCS 3/	Non-Fed. Land FS 3/	Total	Non-Fed. Land SCS 3/	Non-Fed. Land FS 3/	Total	TOTAL
LAND TREATMENT										
Land Areas 2/	Acres									
Cropland	to be	2,635	2,635				11,500		11,500	11,500
Pastureland	treated	27	27				400		400	400
Forest land		20	20					1,000	1,000	1,000
Technical Assistance				8,400		8,400	1,100	1,000	2,100	10,500
TOTAL LAND TREATMENT				8,400		8,400	13,000	2,000	15,000	23,400
STRUCTURAL MEASURES										
Construction										
Floodwater Retarding Structure	Each	1	1	129,300		129,300				129,300
Grade Stabilization Structure	Each	1	1	57,000		57,000				57,000
Channel Work 4/				144,000		144,000				144,000
(M)	Mi.	2.8	2.8							
(O)	Mi.	1.0	1.0							
Subtotal - Construction				330,300		330,300				330,300
Engineering Services				28,020		28,020				28,020
Project Administration										
Construction Inspection				29,820		29,820				29,820
Other				29,120		29,120			700	29,820
Subtotal - Administration				58,940		58,940			700	59,640
Other Costs										
Landrights									99,750	99,750
Subtotal - Other									99,750	99,750
TOTAL STRUCTURAL MEASURES				417,260		417,260			100,450	517,710
TOTAL PROJECT				425,660		425,660			115,450	541,110

1/ Price Base 1973. 2/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas. 3/ Federal agency responsible for assisting in installation of works of improvement. 4/ Type of channel prior to project: (M) manmade ditch or previously modified channel; (O) none or practically no defined channel.

Date: July 1974

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of work plan preparation)

Mission Hill Watershed, South Dakota

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
Soil Conservation Service			
LAND TREATMENT MEASURES			
Conservation Cropping System	Ac.	6,627	15,300
Crop Residue Use	Ac.	6,627	7,600
Contour Farming	Ac.	140	500
Grassed Waterways	Ac.	13	1,900
Terraces	Ac.	51	1,300
Pasture & Hayland Planting	Ac.	209	6,100
Pasture & Hayland Management	Ac.	338	1,000
Ponds	No.	6	2,400
Tree Planting	Ac.	223	29,900
Subtotal			66,000
Forest Service			
Woodland	Ac.	85	8,500
Fire Control	Ac.	8,025	2,500
TOTALS			77,000

1/ Price Base 1973.

Date: July 1974

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Mission Hill Watershed, South Dakota
(Dollars) 1/

Item	Installation Cost P.L. 566 Funds			Instal.Cost-Other Funds		Total Installation Cost
	Construction	Engineering	Total P.L. 566	Landrights	Total Other	
Floodwater Retarding Structure No. 1	129,300	6,500	135,800	53,450	53,450	189,250
Grade Stabilization Structure No. 2	57,000	10,000	67,000	300	300	67,300
Subtotal	186,300	16,500	202,800	53,750 2/	53,750	256,550
Channel Work						
439+60-385+70 (O) 3/	49,500	3,960	53,460	6,100	6,100	59,560
385+70-239+90 (M) 3/	94,500	7,560	102,060	39,900	39,900	141,960
Subtotal	144,000	11,520	155,520	46,000 4/	46,000	201,520
Project Administration			58,940 5/		700	59,640
GRAND TOTAL	330,300	28,020	417,260	99,750	100,450	517,710

1/ Price Base 1973.
2/ Includes land, $19,000; legal and appraisal fees, $1,600; road and bridge, $22,600; farmstead protection, $9,500; fencing, $1,050.
3/ Type of channel prior to project: (M) manmade ditch or previously modified channel; (O) none or practically no defined channel.
4/ Includes land, $12,350; legal fees, $300; road and bridge, $17,000; field crossings, $5,600; relocating utility lines, $9,000; fencing, $1,750.
5/ Includes construction inspection, $29,820; administration of contracts, $2,700; other, $26,420.

Date: July 1974

TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY
Mission Hill Watershed, South Dakota

ITEM	UNIT	Structure Number 1
Class of Structure		c
Drainage Area (Total)	Sq. Mi.	5.85
Curve No. (1-day)(AMCII)		74
Tc	Hrs.	3.8
Elevation Top of Dam	Ft.	1,235.3
Elevation Crest Emergency Spillway	Ft.	1,229.6
Elevation Crest High Stage Inlet	Ft.	1,222.5
Elevation Crest Low State Inlet	Ft.	1,209.0
Maximum Height of Dam	Ft.	37
Volume of Fill	Cu. Yds.	113,600
Total Capacity 1/	Ac. Ft.	930.9
Sediment Submerged first 50 years	Ac. Ft.	37.9
Sediment Submerged second 50 years	Ac. Ft.	39.2
Sediment Aerated	Ac. Ft.	8.4
Retarding	Ac. Ft.	845.4
Between high and low stage	Ac. Ft.	312
Surface Area		
Sediment pool 2/	Acres	(7)
Retarding pool	Acres	100
Principal Spillway Design		
Rainfall Volume (areal) (1 day)	In.	5.04
Rainfall Volume (areal) (10 day)	In.	10.39
Runoff Volume (10 day)	In.	4.78
Capacity of Low Stage (Max.)	Cu.Ft./Sec.	22
Capacity of High Stage (Max.)	Cu.Ft./Sec.	106
Frequency operation - Emergency spillway	% chance	1
Dimensions of conduit	In.	30
Emergency Spillway Design		
Rainfall Volume (ESH) (areal)	In.	9.5
Runoff Volume (ESH)	In.	6.28
Storm Duration	Hrs.	6
Type		Veg.
Bottom Width	Ft.	400
Velocity of flow (V_e)	Ft./Sec.	6.9
Slope of exit channel	Ft./Ft.	.03
Maximum water surface elevation	Ft.	1,231.7
Freeboard Design		
Rainfall Volume (FH) (areal) (6 hrs.)	In.	24
Runoff Volume (FH)	In.	20.24
Storm Duration	Hrs.	6
Maximum water surface elevation	Ft.	1,235.3
Capacity Equivalents		
Sediment Volume	In.	.27
Retarding Volume	In.	2.71

1/ Crest of emergency spillway.
2/ The 7-acre sediment pool will draw down following each runoff event.

Date: July 1974

Mission Hill Watershed, South Dakota

Station	Drain. Area Sq.Mi. 2/	Capacity Cu.Ft./Sec Reqd.	Capacity Cu.Ft./Sec Dsgn.	Water Surf. Elev.	Hydr. Grad. (Ft/Ft)	Channel Dimensions 1/ Bottom Width (Ft.)	Bottom Grade (%)	Depth of Flow (Ft.)	Velocities Ft./Sec. Aged 3/	Velocities Ft./Sec. As Built 4/	Excavation 1,000 5/ (Cu.Yds)	Type of Work 6/	Before Project Type of Chan. 7/	Before Project Flow Cond. 8/
439+60	6.21	111	111	1153.7	.00003	16	0.0	5.7	0.6	0.6	17.4	I	0	9/
433+00				1153.8				5.8	0.6	0.6				
Drop Structure														
433+00	6.21	111	131	1160.2	.00080	16	0.0	2.6	1.79	1.85	2.8	I	0	9/
430+50	6.21	111	111	1160.4	.00044	16	0.0	2.8	1.62	1.77	3.9	I	0	9/
426+50	6.21	111	111	1160.6	.00039	16	.00015	3.0	1.48	1.70	4.1	I	0	9/
420+70	6.21	111	111	1160.8	.00031	16	.00015	3.1	1.41	1.63	20.3	I	0	9/
408+40	6.21	111	111	1161.2	.00024	16	.00015	3.3	1.30	1.56	26.9	I	0	9/
385+70	6.21	111	111	1161.7	.00022	16	.00015	3.5	1.15	1.45	27.2	II	M(1915)	E
368+70	6.21	111	108	1162.1	.00024	16	.00025	3.6	1.15	1.45	77.4	II	M(1915)	E
302+90	5.51	94	94	1163.6	.00016	18	.00023	3.5	1.20	1.45	11.8	II	M(1915)	E
282+80	5.51	94	94	1163.9	.00018	18	.00023	3.4	0.98	1.45	8.2	II	M(1915)	E
239+90				1164.8				3.3	1.02	1.51				

1/ Flow depth based on design capacity, side slope = 3:1. 2/ Includes 2.51 square miles which is partially contributing for large storms. 3/ Based on design capacity, n=0.035. 4/ Based on bankfull capacity (145 cubic feet per second), n=0.025. 5/ Channel enlargement. 6/ I = establishment of new channel including necessary stabilization measures; II - enlargement or realignment of existing channel. 7/ M(1915) - manmade ditch or previously modified channel, 1915 is approximate date of original construction; 0 - none or practically no defined channel. 8/ E - ephemeral - flows only during periods of surface runoff, otherwise dry. (During wet seasons there are small areas of ponded water due to flat grades and irregular channel bottom).

9/ No flow prior to proposed channel construction.

Date: July 1974

TABLE 3B - STRUCTURAL DATA

GRADE STABILIZATION STRUCTURES

Mission Hill Watershed, South Dakota

Structure Number	Drainage Area (Sq.Mi.)	Design Cap. Prin. Spill. (Cu.Ft./Sec.)	Assoc. Frequency and Duration of Storm (% chance and hours)	Drop (Feet)	Concrete (Cu.Yds)	Type of Structure
2	12.06 1/	375	1%-6 hrs.	9.6	110	Straight Drop Spillway

1/ Floodwater retarding structure Number 1 controls 5.85 square miles of this drainage area.

Date: July 1974

TABLE 4 - ANNUAL COST

Mission Hill Watershed, South Dakota

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Floodwater Retarding Structure	13,030	640	13,670
Grade Stabilization Structure	4,630	290	4,920
Channel Work	13,870	650	14,520
Project Administration	4,110		4,110
GRAND TOTAL	35,640	1,580	37,220

1/ Price base 1973.
2/ 100 years @ 6-7/8 percent interest.

Date: July 1974

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Mission Hill Watershed, South Dakota

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	37,700	4,300	33,400
Other Agriculture	4,100	500	3,600
Nonagricultural			
Road and Bridge	1,500	300	1,200
Urban	900	-0-	900
Subtotal	44,200	5,100	39,100
Sediment			
Road and Bridge + Channel	1,570	280	1,290
Other			
Hayland and Pasture	880	330	550
Yards and Gardens	80	20	60
Subtotal	2,530	630	1,900
Indirect	4,670	570	4,100
Total	51,400	6,300	45,100

1/ Price Base - 1973.
Agricultural damages were based on adjusted normalized prices.

Date: July 1974

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Mission Hill Watershed, South Dakota

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/ Flood Prevention					Total	2/ Average Annual Cost	Benefit Cost Ratio
	Damage Reduction	More Intensive Land Use	Changed Land Use		Secondary			
			Agr.	Urban				
Flood Retarding Structure #1 Grade Stabilization Structure #2 Channel Work	42,800	2,800	-0-	-0-	23,900	69,500	33,110	2.1:1.0
Project Administration							4,110	
GRAND TOTAL	42,800 3/	2,800	-0-	-0-	23,900	69,500	37,220	1.9:1.0

1/ Price base 1973.
2/ From Table 4.
Note: Benefit cost ratio-primary benefits 1.4:1.0 (Benefit cost ratio is 1.2:1.0 with project administration included.)
3/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $2,300 annually.

Date: July 1974

INVESTIGATIONS AND ANALYSES

Hydrology and Hydraulics

A history of flooding in the town of Mission Hill was obtained by interviewing residents whose homes had been flooded. Water surface profiles were computed through this area using automatic data processing. Theoretical peak flows were determined for various frequencies and the elevations of these peaks were used to establish a curve of elevation versus percent chance of occurrence at several points in the flood area.

The elevations of the homes were obtained from field surveys. A table was prepared showing the depth of flooding versus frequency for each of the homes in the flood plain. This table was used in the economic evaluations.

With the proposed floodwater retarding structure in place, future hydrographs were developed and combined with the outflow from the structure. The peak elevations resulting from the 100-year frequency runoff combined with the outflow from the structure is less than the elevation of the homes.

The flood plain below Mission Hill crosses the Missouri River flood plain. Floods from the Missouri River are controlled by upstream reservoirs. The watershed is very flat in this area and the boundary is very difficult to define. Peak flows coming through Mission Hill are quickly dissipated and spread out on the relatively large flat agricultural area. Because of these flood plain characteristics, floodrouting was not attempted.

A flood occurred on the watershed during early investigations. Data gathered from that flood was useful in analyzing the effects of an intense rainfall. The area flooded by the storm of May 22, 1966, was measured after being

outlined on aerial photos immediately following the flood. Rainfall data from gages of farmers living in or near the watershed were also gathered and isohyetals of the rainfall were drawn. Runoff was computed using the cover number existing at the time of the storm.

A runoff versus percent chance of occurrence curve was developed using 24-hour duration storms and the cover number adjusted to normal area conditions (antecedent moisture condition between I and II). The curve was entered with the runoff from the May 22 storm and the percent chance of occurrence of the runoff was determined.

Interviews with flood plain operators in the frequently flooded area helped to establish the limits of a flood considerably larger than the May 22 flood. That flood approaches the maximum possible area flooded in Reaches II, III, and IV since additional floodwaters spill over into other watercourses outside the watershed. This area was measured as the 100-year frequency flood. Further interviews with flood plain operators revealed that some flooding from summer storms occurs every year in some areas. This information was used to develop a curve of percent chance of occurrence versus acres flooded from which the average annual acres flooded were determined. By combining the curves previously constructed, runoff versus acres flooded was developed for later use in measuring the effects of the structural works of improvement.

Flood boundaries adjacent to the channel in Reach I were determined by interviews, field observations of the area, and by examination of topographic maps. Determination of actual area benefited for extreme floods was difficult and arbitrary in most places since this magnitude of flooding is infrequent.

Consideration was given to changes in channel capacity brought about by continued farming operations through the channel and the effect of heavy rains in the immediate area.

The volume of runoff from a series of storms on the uncontrolled area was determined. The design of the channel was based on removal of that volume of water within a 24-hour period. A 2-year, 24-hour; 5-year, 24-hour; and a 10-year, 24-hour removal channel were considered as alternates. Additional channel capacity for the outflow from the floodwater retarding structure was provided.

The volume of water remaining after 24 hours was used to enter the curve of acres flooded versus runoff to determine the remaining acres flooded for the storms not controlled by the structure and channel. These remaining acres were then plotted to show acres flooded versus percent chance of occurrence. The average annual acres flooded under future conditions were determined from this curve.

Economics

Estimated damages to agriculture were based on interviews obtained in the field from approximately 85 percent of the flood plain operators. The information gathered covered land use, crop distribution, yields, and flood damages to crop and pastureland. Additional information was obtained from the local Soil Conservation Service personnel and the County Extension Agent.

The above information was used to determine composite acre values. Due to the poorly defined drainage system in the Mission Hill flood plain, the over-land flow method of analysis was used. This method is presented in Chapter 3 of the

Economics Guide for estimating damage. Analyses of the information obtained from the interviews on flood damage and damage schedules were set up to determine crop damages by months. The percent damage rates were weighted by the percent chance of storms occurring each month to provide a monetary value of damages. Two evaluation reaches were used. The weighted dollar damage per composite acre was applied to the average annual acres flooded.

Other agricultural damages such as spreading of noxious weeds, livestock diseases, fence damage, flood fighting and cleanup costs were determined by the information obtained from the operators who farm the land in the flood plain and by onsite inspection. This information includes both out-of-pocket costs and loss of time.

Road and bridge dollar damage estimates were obtained from county and township road officials and by the local farmers. This information was plotted on a dollar damage versus percent chance of occurrence curve to determine annual damages under present conditions. Basic data for damages to homes in Mission Hill were obtained by door to door interviews. Using the table of depth of flooding versus frequency, the dollar damages were determined and correlated with the flood damage estimate tables compiled by the Corps of Engineers. This dollar damage versus percent chance of occurrence curve was plotted to determine annual damages under present condition. With the 100-year flood protection provided by flood retarding structure number 1, the annual damage will be reduced to zero. No consideration was given to floods greater than the 1 percent chance event.

The present flood free yields in the flood plain were adjusted to reflect the increase in yields that can be expected from the use of advanced technology

and high level management. The adjustments were based on the assumption that management and production practices now used by the more progressive farmers will be in general use over the project life.

Indirect damages from floods include additional costs of extra feed for livestock, losses due to interruption of feeding schedules following floods, rerouting of mail deliveries, additional travel for farmers, etc. Based on data obtained from other watersheds analyzed and information gathered in this watershed, it is estimated that these damages are 10 percent of all direct damages.

The agricultural program will be more stable with the project installed. Consideration was given to the effect of damage to the higher values per acre from remaining flooding. The added production, harvesting, and other costs were deducted from the increased value of production. Benefits were discounted over a 5-year lag in accrual.

The multiplier effect was used to determine secondary benefits stemming from the project. This technique quantifies the indirect and induced effects of installing a new resource project on the surrounding region. A 12-county Planning and Development District, designated by the State of South Dakota, includes the watershed and was used to determine the magnitude of the multiplier effect.

The authority for computing the adjusted normalized prices is the report of the Interdepartmental Staff Committee of the Water Resource Council dated April 1966.

Installation costs of channel improvement and the floodwater retarding structure were amortized at 6-7/8 percent for 100 years.

Engineering

A diversion was considered in lieu of the floodwater retarding structure. The floodwater retarding structure was chosen because it was more in harmony with the environment, resulted in less disturbance of wildlife habitat and less total cost. It also reduced downstream peak flows and reduced sediment moving to downstream areas. The spillway hydrographs for the structure were routed using electronic data processing. The computer program for this routing is based on current Service criteria.

Several alternate channel outlet locations were considered. The final location was selected because it offered a stable outlet, disturbed a minimum amount of wildlife habitat, was the least costly, and was more in harmony with the present environment.

The hydraulic design of the channel was based on Manning's Formula. Values used were .035 for "aged" and .025 for "as-built", Manning's "n". The allowable velocities for "aged" and "as-built" conditions were estimated using the procedures in SCS, Engineering Technical Release No. 25.

Geology

Sediment estimates for the watershed were made using Musgrave's Formula. The delivery ratio used for the structure design and damage estimates was 18 percent and was taken from standard delivery ratio curves.

Soils were estimated to have an inplace, or original, density of 90 pounds per cubic foot. Submerged and aerated sediment were estimated to have densities of 65 and 85 pounds per cubic foot, respectively. Holes were drilled along the proposed channel and samples of each material found were

tested at the Soil Mechanics Laboratory in Lincoln, Nebraska. The testing indicated soils generally fine grained and low plasticity.

Foundation drilling was done on the planned floodwater retarding structure. The abutments consist of a thin loess cap over glacial till. The Niobrara or Carlile Formation is under the till at unknown depths. The glacial till is at least 15 feet thick on the abutments and alluvium in the valley bottom is at least 35 feet thick. Embankment materials will be loess and glacial till. The material is suitable and the quantity is adequate for the proposed structure.

Land Use and Treatment

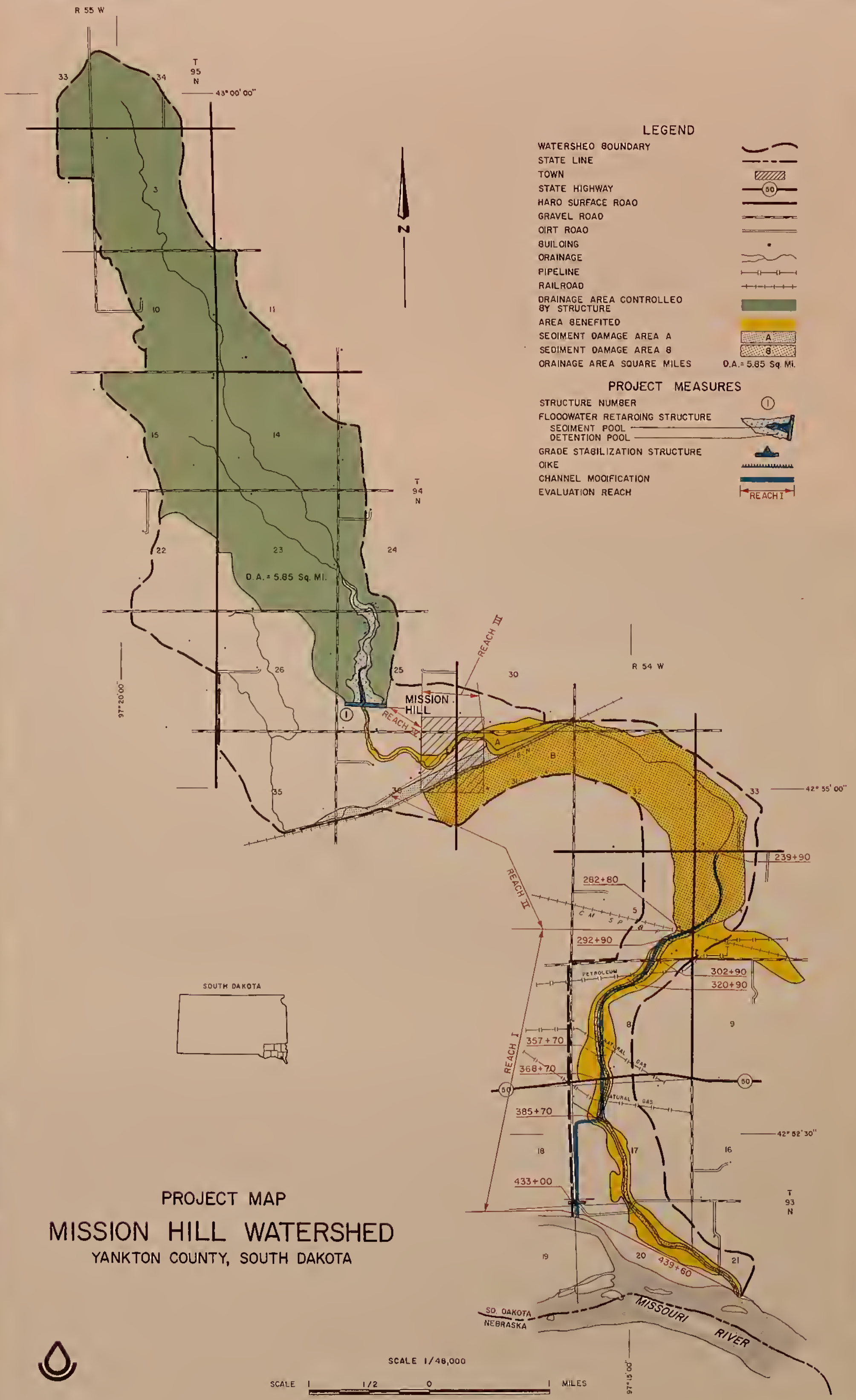
The planned, applied, and needed land treatment measures were recorded by a joint effort of the district conservationist and planning staff economist. This information was taken from the work unit files and supplemented by onsite inspection and knowledge of the local area.

Fish and Wildlife

An investigation of the effects of the project on fish and wildlife was conducted by the Soil Conservation Service Biologist. Consideration was given to the losses of habitat due to construction and the gains from the installation of the vegetative measures. The results have been incorporated into the work plan.

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



PROJECT MAP

MISSION HILL WATERSHED

YANKTON COUNTY, SOUTH DAKOTA

SCALE 1/48,000

SCALE 1 1/2 0 1 MILES

SOURCE
USGS 1/24,000 SCALE QUADRANGLE MAPS,
AND INFORMATION FROM FIELD TECHNICIANS.

POLYCONIC PROJECTION

5-30-73

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